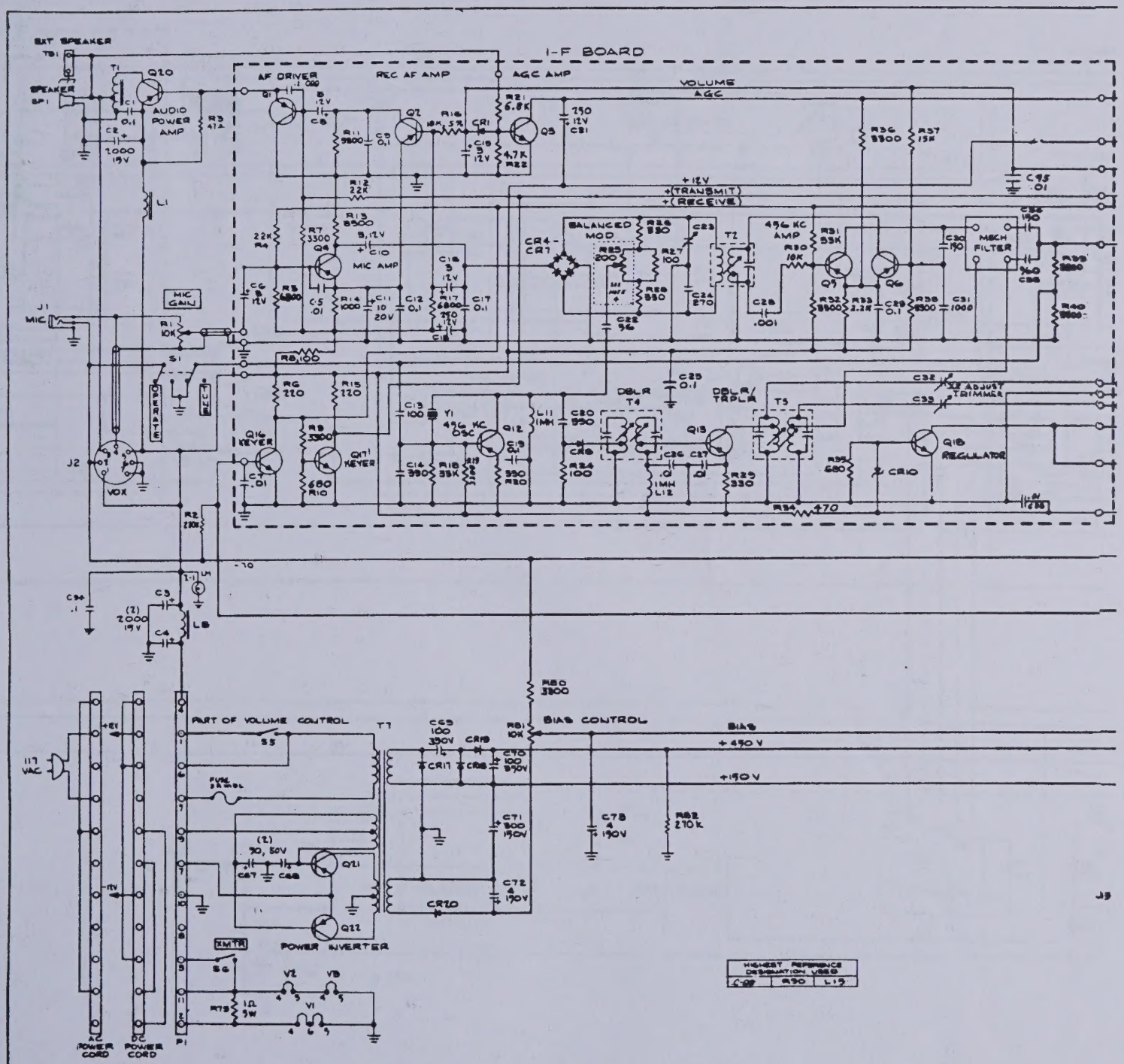
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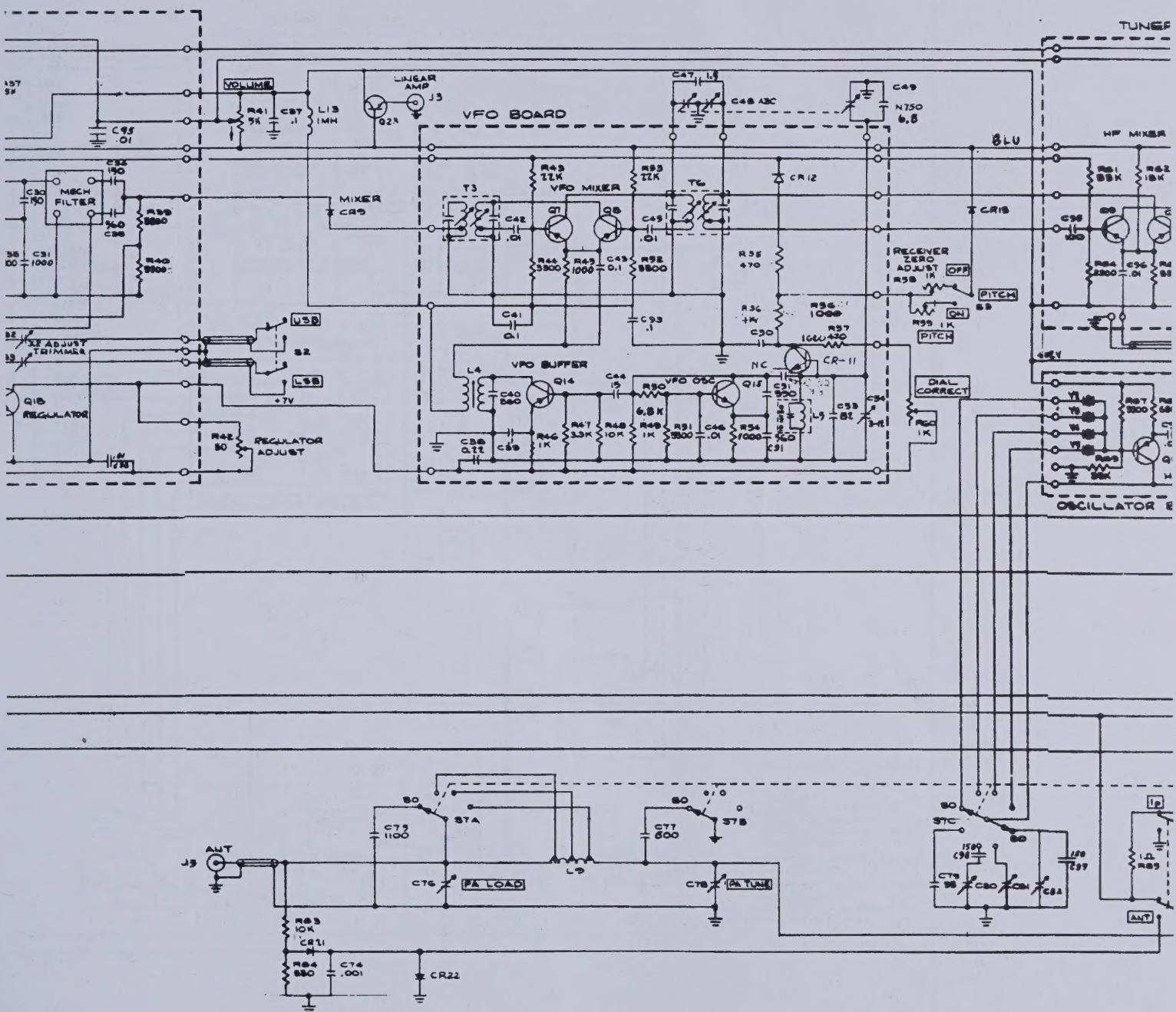
AF DRIVER
REC AF AMP
AGC AMP
VOLUME AGC
AUDIO POWER AMP
MIC AMP
MIC GAIN
BALANCED MOD
496 KC AMP
MECH FILTER
DBLR T4
DBLR/ TRPLR T5
SSB ADJUST TRIMMER
REGULATOR
VOX
PART OF VOLUME CONTROL
BIAS CONTROL
BIAS
+450 V
+190 V
POWER INVERTER
XMTR
117 VAC
AC POWER CORD
DC POWER CORD
HIGHEST FREQUENCY DESIGNATION USED
C-97
R-90
L-13

SBE-34


VFO BOARD
VOLUME
LINEAR AMP
J3
MECH FILTER
MIXER
CR9
VFO MIXER
T3
T6
CR12
CR13
VFO BUFFER
VFO OSC
Q14
Q15
CR-11
NC
RECEIVER ZERO ADJUST
OFF
ON
PITCH
DIAL CORRECT
REGULATOR
REGULATOR ADJUST
XF ADJUST TRIMMER
USB
LSB
+7V
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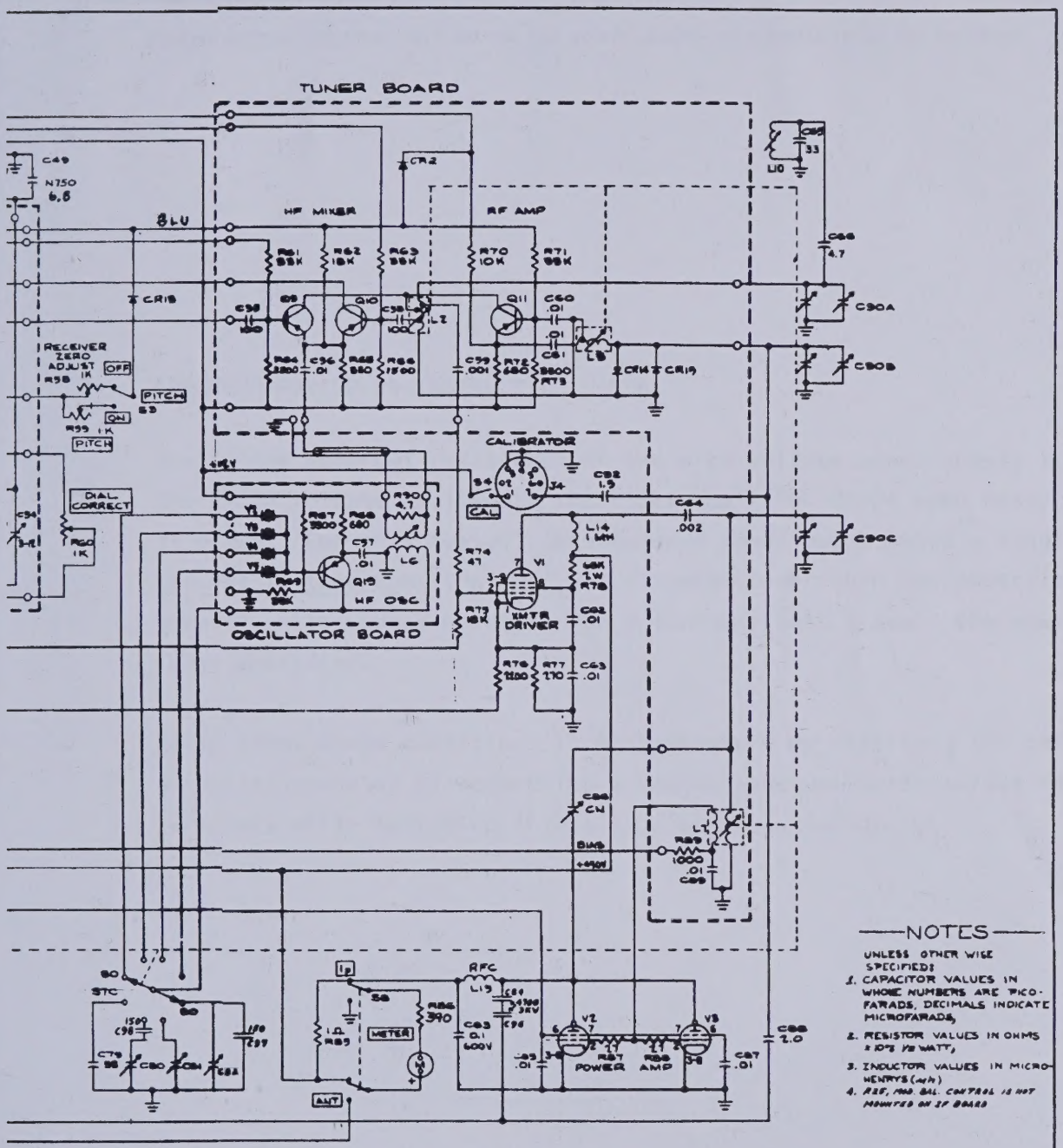
HF MIXER
OSCILLATOR
ANT
PA LOAD
PA TUNE
S7A
S7B
S7C
CR21
CR22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RF AMP
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BLU
CR18
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R58
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PITCH
R99 1K
ON
S3
DIAL CORRECT
R60 1K
CALIBRATOR
CAL
HF OSC
OSCILLATOR BOARD
VMTR DRIVER
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BIAS
+250V
METER
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SIDEBAND ENGINEERS. 317 ROEBLING ROAD, SOUTH SAN FRANCISCO, CALIFORNIA 589-9245 AREA CODE 415

ADDENDUM FOR SB-34 INSTRUCTION MANUAL

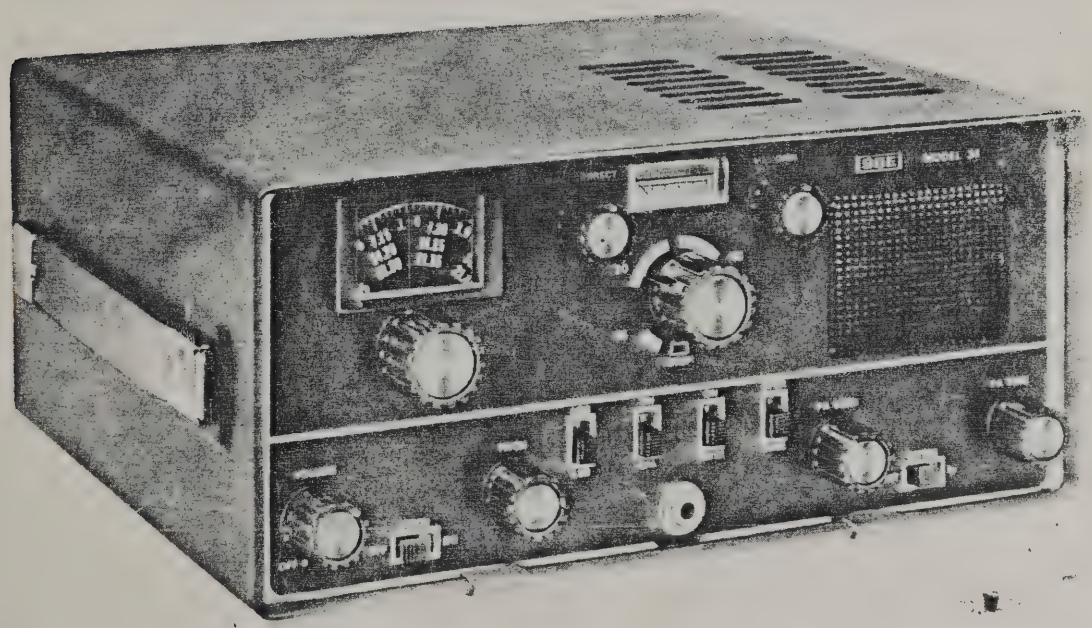
Due to the internal resistance of the high voltage power supply in the SB-34, the plate voltage applied to the final amplifier drops when heavy plate current is drawn. For this reason, the measured power output with a single tone (or the set in tune position) will be somewhat lower than the advertised value. However, with speech waveform, or a two-tone test signal, the power output is as specified.

Power under these conditions is best measured by observing the deflection on an oscilloscope or by connecting a vacuum tube voltmeter across the antenna terminals while operating into a load of known impedance.

ORIG

OPERATION and MAINTENANCE MANUAL

SB-34 SINGLE SIDEBAND TRANSCEIVER



SBE SIDEBAND ENGINEERS

317 ROEBLING RD—SOUTH SAN FRANCISCO, CALIF.

SIDEBAND ENGINEERS. 317 ROEBLING ROAD, SOUTH SAN FRANCISCO, CALIFORNIA 589-9245 AREA CODE 415

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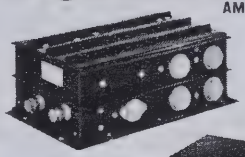
Power under these conditions is best measured by observing the deflection on an oscilloscope or by connecting a vacuum tube voltmeter across the antenna terminals while operating into a load of known impedance.

SB-34

your biggest dollar value with built-in 12V DC and 117V AC power supply

SB-2LA LINEAR AMPLIFIER

SB3-DCP INVERTER



SB-34
SSB transceiver

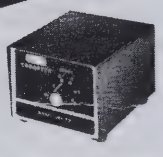
SB2-XC CALIBRATOR

SB2-VOX

SB2-MB MOUNTING PLATE

SB2-MIC MICROPHONE

CODAPTER



SBE SSB TRANSCEIVERS AND ACCESSORIES

SIDEBAND ENGINEERS

SB-34, four-band SSB transceiver . . . your biggest dollar value! Price of **395.00 includes** built-in power supply for **both 12V DC and 117V AC** operation. Connect SB-34 directly to 12 volt vehicle battery using DC cable or plug it into wall outlet using AC cable. (Both cables are furnished.) No inverters or other supplementary equipment needed.

SB-34 provides 250 kc on 80-40-20-15 meter bands, also covers MARS frequencies. Fully transistorized except for 2-6GB5's in PA and 12DQ7 in RF driver. Exceptionally low current drain. Panel switch turns off tube filaments and power supply for casual mobile listening. In this standby mode receiver draws only 500 ma from car battery. Transistor/diodes, bilateral circuitry greatly reduce equipment size—cabinet volume is less than one-third cubic foot. This is lightweight equipment too, weighs less than 20 pounds.

Dozens of advanced features: USB or LSB by panel switch. Collins mechanical filter with steep slopes. Solid-state switching—**no relays.** Delta receiver tuning ± transmitter frequency. Solid-state varactor dial corrector. Single-knob dual-speed tuning. Loudspeaker is built in. **SB-34** is prewired for VOX and 100 kc calibrator accessories, has receptacles on rear of housing. **Frequency range:** 3775-4025 kc, 7050-7300 kc, 14.1-14.35 mc, 21.20-21.45 mc Power input is 135W p.e.p. (slightly lower on 15 meters). Excellent solid-state receiver has sensitivity of 1 microvolt for 10 db signal/noise ratio.

Suggested price: **395.00**

SB-2LA LINEAR AMPLIFIER operates at 1KW p.e.p. input on 80-40-20 meters, 750 watts on 15 meters. This compact amplifier is designed as a companion unit to the **SB-34** but will also boost the ouput of **any** SSB transceiver to a full KW. Drive requirement is from 60 watts upward depending upon amplifier power output. **SB-2LA** has a passive grid input circuit, offers a pure resistive load to the exciter. This amplifier has a pi network and band switching.

SB-2LA uses low plate voltage and high plate current. This low voltage, only 800 volts, is far easier on capicitors, diode rectifiers, power transformers—offers safer operation under environmental extremes. Built-in, all-solid-state 117V AC power supply is voltage multiplying type so that transformer secondary voltage is only a fraction of the already-low DC output voltage. Filter capacitors have high capacity for dynamic regulation. Tubes used are low cost, standard types; six, parallel-connected 6JE6's being used.

SB-2LA has built-in antenna control relays (2) and internal blocking bias. Two panel meters read plate current and output. Switches for HI-LO power and TUNE-OPERATE simplify adjustment. Cabinet is heavy-gauge steel with dull black, durable epoxy finish. Panel is black with satin aluminum trim. Knobs are black with bright nickel inserts. Cabinet size is 5¼"H, 11¾"W, 11⅝"D (plus projections). Shipping weight 43#.

Suggested price: **249.50**

SB3-DCP INVERTER is heavy-duty, fully transistorized for use with **SB-2LA** and **SB1-LA** linear amplifiers when operating mobile KW. Output is 120V AC at 1200 watts, input is 12V DC. Relays and complete instructions are included. Size: 6"W, 12"D, 3¾"H. Shipping weight 17#.

Suggested price: **249.50**

MODEL SB2-VOX . . . voice operated control for **SB-34** transceivers. Unit mounts on rear of **SB-34** chassis, plugs into receptacle provided. No modifications or other connections needed. VOX has controls for **Gain—anti-trip—delay.** Shipping weight, 1#.

Suggested price: **34.50**

MODEL SB2-XC CALIBRATOR . . . provides 100 kc marker signals for **SB-34.** Unit mounts on rear of **SB-34** chassis and plugs into receptacle provided. Calibrator is controlled by ON-OFF switch on **SB-34** transceiver panel. Shipping weight is 10 ozs.

Suggested price: **24.50**

SB2-MIC MICROPHONE is a dynamic type with excellent speech quality for use with **SB-34.** Attractive gray housing, press-to-talk switch and shielded coil cord with 3-circuit plug. Shipping weight, 18 ozs.

Suggested price: **14.50**

CODAPTER . . . CW adapter for **SB-34** or other well-designed SSB transceivers with adequate carrier suppression. Operates upon principle that when pure audio tone is introduced into audio circuits of SSB transceivers, the RF output is an unmodulated signal. **CODAPTER** generates stable, low distortion tone which is patched into microphone jack on the **SB-34** and keyed in the usual manner. Keying is break-in with the first key-closed pulse energizing transceiver send-receive circuits. Hold time is adjustable, VOX fashion, for slow or fast drop out. Keying is shaped to prevent click and tails. Unit uses 5-silicon transistors, 2 diodes, no tubes. 117V AC supply built in. Also operates on 12V DC for mobile. Shipping weight 48 ozs.

Suggested price: **39.95**

SB2-MB MOUNTING PLATE . . . convenient vehicular mount for **SB-34.** Straps supplied allow arrangement of plate over hump on floor of car. Push slide engages set cabinet, can be locked with padlock supplied. 3#.

Suggested price: **12.50**

RAYTHEON **RAYTHEON COMPANY**

213 E. Grand Avenue, So. San Francisco, California 94080

Export sales: Raytheon International Sales & Services, Lexington 73, Massachusetts U.S.A. **Prices and specifications subject to change.**

SBE WARRANTY

The Sideband Engineers equipment described herein is sold under the following guarantee:

SBE agrees to repair or replace, without charge, any equipment, parts, or accessories which are defective as to workmanship or materials and which are returned to SBE at its factory or an authorized warranty station, transportation prepaid, provided:

1. Notice of the claimed defect is given SBE or an authorized warranty station, or an authorized Distributor, in writing, within 90 days from the date of purchase and goods are returned in accordance with SBE instructions.

2. The warranty registration card has been filed within 10 days from date of purchase.

3. Equipment, accessories, tubes, semi-conductors and batteries not manufactured by SBE or from SBE designs are subject to only such adjustments as SBE may obtain from the supplier.

4. Failures due to use of equipment for purposes other than normal amateur operation or in violation of the SBE instruction manual shall not be deemed a defect.

This Warranty is not valid if the equipment is altered, modified or repaired by persons other than SBE or an authorized warranty station. Alteration or modification in accordance with SBE Service Bulletins shall not affect this Warranty.

SBE reserves the right to make any change in design or to make additions to, or improvements in SBE products without imposing any obligation upon SBE to install them in previously manufactured SBE products.

No other warranties, express or implied, shall be applicable to this equipment, and the foregoing paragraphs shall constitute the Buyer's sole remedy under the agreements contained in this Warranty. In no event shall SBE have any liability for damages, loss, or expense directly or indirectly arising from the use of the product, or any inability to use them either separately or in combination with other equipment or from any other cause.

For Warranty Service see inside back cover.

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Transistor Voltage Chart
Tube Voltage Chart
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Printed in U.S.A.

I. GENERAL DESCRIPTION

The Sideband Engineers Model SB-34 is a single-sideband, suppressed-carrier transceiver intended for operation in the A3 portions of the U.S. 80, 40, 20 and 15-meter amateur bands. The SB-34 operates either upper or lower sideband; selection is made by a front-panel switch. There is no carrier shift when emission is changed from one sideband to the other. Peak effective power output exceeds 60 watts on the 80, 40 and 20-meter bands, and 50 watts on the 15-meter band.

The SB-34 is self-contained, requiring only a microphone and an antenna for operation. The SB-34 will operate from either a 117-volt AC, or 12-volt DC (negative ground) power source; the two-way power supply is an integral part of the unit. Selection between the two power sources is automatically made when the proper line cord is connected.

Provisions are made for the use of a VOX unit and a 100-kc crystal calibrator which are available as accessory items. A front-panel switch is provided to control the calibrator unit. An accessory plug is also provided on the rear panel for control of the Sideband Engineers external Linear Amplifier companion unit.

All stages of the SB-34 except the transmitter driver and power amplifier are transistorized. The use of bilateral amplifiers and mixers, which amplify in one direction on transmit and in the other direction on receive, permits the use of a single bandpass circuit train. Duplication of circuitry is eliminated through use of common circuit elements for both receive and transmit functions.

The unique bandswitching and exciter tuning control permits adjustment of both functions with a single front-panel knob. Other controls and adjustments are held to a minimum for simplified operation. Exceptional receiver performance is obtained through the use of post-alloy diffused transistors and a 2.1-kc Collins mechanical filter. A pitch control is provided for tuning the receiver approximately 500 cycles either side of the transmitted frequency. The control may be disabled and the receiver locked to the transmitted frequency. A standby switch is also provided to turn off the transmitter-tube heaters and the high-voltage power supply during mobile operation. With this switch off, power drain from the car battery is reduced to 0.6 amps.

The entire transceiver package is less than one-half cubic foot in volume and weighs approximately 18 pounds. Construction of heavy-gauge steel and aluminum, and extensive use of printed circuit boards, provide an extremely rugged package, virtually immune to the effects of vibration and shock.

II. SPECIFICATIONS

Type of emission:	Single sideband, suppressed carrier, upper or lower sideband selectable from front panel
Frequency range:	3.775 - 4.025 mc, 7.05 - 7.3 mc, 14.1 - 14.35 mc, 21.25 - 21.45 mc
Power consumption:	117 VAC - receive 35 watts - transmit (single tone) 165 watts 12 VDC - standby 0.6 amps - receive 3.6 amps - transmit (single tone) 14 amps
Power output (PEP):	80, 40, 20 meters: 60 watts minimum 15 meters: 50 watts minimum
Carrier suppression:	50 db
Unwanted sideband suppression:	40 db at 300 cycles
Distortion products:	Down at least 25 db
Spurious responses:	Down at least 40 db
Antenna output impedance:	40 - 100 ohms, unbalanced. VSWR not to exceed 2:1
Sensitivity:	Less than 1 microvolt for 10 db signal-to-noise ratio
Selectivity:	2.1 kc at 6 db down, 4.5 kc at 60 db, both transmit and receive
Audio output:	2.0 watts at 10% distortion, 3 watts maximum
Dimensions:	5" high, 11-1/8" wide, 9-1/2" deep
Weight:	Approximately 18 pounds

III. INSTALLATION

1. GENERAL

The SB-34 transceiver is designed to provide a complete single-unit installation for fixed, portable, or mobile operation. No special precautions need be observed in the choice of location provided adequate ventilation space is available. A minimum of two inches of air space above the cabinet top and on all sides is recommended to allow proper air flow around the top and bottom of the cabinet. Do not place the unit on a car seat or similar surface which may block ventilation through the bottom. Never stack other units above or below the cabinet since the accumulated heat could cause permanent damage.

2. FIXED STATION

Plugging the 117-volt AC power cord into the receptacle at the rear of the transceiver connects all power circuits for 117 volt AC operation. The set

should be connected to a good water-pipe ground. The ground may be connected either to the external speaker terminal labelled GND or to the braid of the antenna cable.

3. ANTENNA

Results both in receiving and transmitting will depend largely on the antenna; the receiver is particularly sensitive to the type of antenna used. Any of the common antenna systems designed for use on the high-frequency amateur bands may be used with SB-34 provided the input impedance of the antenna system is within the capability of the pi-output matching network (40 - 100 ohms resistive). If tuned open-wire transmission line is used, or if a long wire antenna is desired, a suitable antenna tuner must be used between the transceiver and the antenna to provide an impedance match between the unbalanced coaxial output and the balanced open-wire line or long wire.

4. LINEAR AMPLIFIER

The SB-2 LA linear amplifier has been designed for use with the SB-34 and matches the SB-34 in physical appearance. The required switching and control circuits are incorporated. In addition, the SB-34 transceiver may be operated in conjunction with other conventional linear amplifiers. A plug on the rear panel provides a 12-volt DC potential for actuating the control relays of the amplifier selected when the transceiver switches to transmit. If the linear amplifier relays are not intended to operate from such a voltage, an intermediary relay must be used. Any 12-volt relay may be used provided the coil resistance is 100 ohms or more.

5. MOBILE OPERATION

The SB-34 will operate satisfactorily from any 12-volt negative-ground battery source by connecting the DC power cord to the rear-panel receptacle. Due to the unusually small size of the SB-34, under-dash mounting is possible in many cars with limited available space. The Model SB-2 MB Mounting Bracket is available as an accessory.

When making connections to the car battery, be certain that the RED lead is connected to the positive (+) terminal and the BLACK lead to the chassis ground (-); reversed connections could permanently damage the transceiver. It is strongly recommended that the red lead be connected directly to the battery and not to the ammeter or an accessory terminal.

Note: Prior to operating the SB-34 in a mobile installation, the automobile voltage regulator setting should be checked. Many times, even in new cars,

the regulator is adjusted for an excessively high charging voltage. In addition to being injurious to the car battery, this high voltage could cause permanent damage to the SB-34. Make certain before operating that the voltage, when charging, does not exceed 14.6 volts.

Most of the commonly used mobile antennas will give excellent results with the SB-34. Make certain that the outer braid of the coaxial cable is securely grounded to the chassis at the antenna mount.

Noise generated by the ignition system, generator, etc., will usually interfere with weak-signal reception, especially on the higher-frequency bands. Since procedure for eliminating this noise varies with different makes and models of cars, no specific instructions for noise reduction can be given here. Valuable noise reduction information is given in the Amateur Mobile Manuals and these publications should be consulted or one of the several ignition noise suppression kits available should be considered.

If a mobile installation of higher power is desired, the Sideband Engineers companion Linear Amplifier is recommended for use with the SB-34. A special solid-state inverter is available for use with the amplifier to provide a practical 1000-watt mobile installation. Contact your dealer or Sideband Engineers for further particulars.

IV. OPERATION

NOTE: The SB-34 transceiver has been specifically designed to provide the utmost ease of operation and adjustment. All panel controls have been thoroughly tested before shipment from the factory. Several of the controls are unusual in operation, however, and improper adjustment may result in signals of poor quality, and even out-of-band operation. Read this section carefully before attempting to operate the transceiver.

1. CONTROL FUNCTIONS

The various front-panel controls and their functions are described in detail in the following paragraphs. Make certain that you understand the function of each control before attempting to operate the transceiver. Detailed instructions are given for tuning the transmitter. The design of the unit is such that when the transmitter is properly tuned, the receiving portion of the set is also properly aligned to the frequency in use.

1.1 Volume Control. The power ON/OFF switch and volume control functions are combined on a single control knob located at the lower left corner of the

front panel. Operating the knob clockwise beyond the click turns the unit on. Since the receiver portion of the unit is completely transistorized, no warm-up period is required.

A unique AGC system is incorporated in the SB-34. As the volume control is advanced, strong AGC action occurs as the set reaches normal room volume. From this point on, the volume remains substantially constant until the control is about three-quarters advanced. Beyond this point, the volume rises rapidly until full audio output is obtained with the control fully clockwise. For home use, the volume control is normally operated in the first half of its range. With mobile operation, where more audio output is usually required, the control is advanced into the second half of its range. Keeping the volume control at a low, but comfortable, level will reduce the "pumping" action that may occur on SSB signals.

1.2 Tuning Knob. The large knob directly below the dial window controls the actual frequency of operation after the desired band has been selected. A dual-speed reduction drive is incorporated to provide a slow tuning rate and, at the same time, to cover the entire band rapidly. In operation, the knob is turned to the desired portion of the frequency band and slightly past the desired frequency. When the knob rotation is reversed, the vernier action is increased by six for one complete revolution. Further rotation again engages the quick drive action. Since the tuning rate, in slow drive, is 14 kc per revolution, there is no critical "feel" to the dial. An additional feature of this mechanism is that the dial is positively locked to prevent mechanical frequency drift under vibration.

1.3 Microphone Connector. The microphone jack is located at the lower center of the panel. The jack accepts a type PL-68 (small diameter) plug with the microphone connected to the sleeve and the push-to-talk switch connected to the tip. The SB-34 transceiver is designed to operate with a medium or high-impedance dynamic microphone such as the SBE Model SB2-MIC. Crystal or ceramic microphones will give poor results unless an auxiliary pre-amplifier is used, because of the very high impedance of the microphone and the low-impedance transistor microphone amplifier. In addition, the rising characteristic of this type of microphone combined with the narrow bandpass of the mechanical filter employed in the SB-34 produces a somewhat unpleasant sound to the average voice. Carbon microphones will operate only if external provisions are made for supplying them with operating current.

1.4 Bandswitch. The bandswitching and exciter tuning functions are combined in a single knob located just below the meter. With the knob indication fully clockwise, the transceiver is set for 80 meters, and the front end of the receiver is peaked by rotating the knob through the arc labelled "80". Correct tuning is indicated by a sharp rise in background noise similar to that obtained

with the "antenna tuning" control on a conventional receiver. To change to 40 meters, the knob is rotated counter-clockwise beyond the 80-meter arc. A click will be heard between the 80 and 40-meter arcs. This is the bandswitch operating to the 40-meter position. Tuning is again performed by rotating the knob within the 40-meter arc for a sharp rise in noise. This is progressively repeated for operation on the 20 and 15-meter bands. A stop is provided at the extreme counter-clockwise end of rotation past the 15-meter arc. WARNING! Do not attempt to move the knob past this stop! Damage may result. The knob may slip and cause loss of calibration. If this should happen, turn the bandswitch knob fully clockwise, loosen the set screws and set the knob index exactly on the clockwise stop mark on the panel. Tighten the set screws securely. Further adjustment of the bandswitch knob is covered in the TRANSMITTER TUNEUP section.

1.5 Pitch Control. The pitch control, located to the right of the volume control, provides a means for tuning the receiver frequency slightly to either side of the transmitting frequency. Thus, it is possible to set the pitch of the voice you are receiving to the most readable point without affecting your transmitting frequency. Its use is particularly valuable in "net" contacts where several of the participants may be transmitting slightly off frequency. The pitch control may be switched off and the receiver locked to the transmitting frequency by operating the PITCH switch (between the volume control and the pitch control) to the OFF position. Normally, you will want to keep the pitch control turned off until the initial contact is made. After accurately zeroed with the other station, the pitch control may be used to correct for any drift at the other end of the contact. This technique prevents the "leap-frogging" so prevalent with transceivers.

1.6 Dial Correct. The dial correct knob, located to the right of the dial window, is used to adjust for any error in dial calibration. The transceiver is aligned at the factory for correct dial readings with the correct knob index straight up. If an accurate calibration signal is not available, the correct knob should be left in this position. An accessory 100-kc calibrator unit is available for accurately setting the dial. Alternately, the dial can be corrected on a signal of known accuracy. The use of other amateur signals for this purpose is, in general, not advisable. The calibration of many amateur transmitters is subject to question.

1.7 USB/LSB Switch. This switch sets the transceiver to receive and transmit on either the upper sideband or the lower sideband. In general, it is common practice to use lower sideband on 80 and 40-meter band frequencies, and upper sideband on 20 and 15-meter frequencies. However, occasionally you will find exceptions. If the signal cannot be made intelligible by any amount of tuning, it is probably transmitting the sideband opposite to that which is selected on the USB/LSB switch. Changing the position of this switch does not disturb the dial calibration and no retuning is required.

1.8 CAL Switch. This switch controls the 100-kc calibrator unit which is an accessory item. Moving the switch up to the ON position inserts a beat signal every 100 kc on all bands.

1.9. XMTR Switch. With this switch in the down position, the transmitter tube heaters and the high-voltage supply are turned off when the transceiver is operating mobile. This reduces battery drain to 0.6 amps and thus permits long periods of listening without fear of excessive battery drain. Operating the switch to the ON position actuates the high-voltage supply and the tube heaters. An audible hum from the built-in DC power supply transformer will be evident with the switch in the ON position; however, the hum level is low and will not interfere with the reception of a signal in the normal mobile environment. After a 30-second warm-up period, the transmitter is ready for operation. The XMTR switch operates only when the set is powered from a 12-volt DC battery; it does not function with 117-volt AC operation. With 117 volts AC, the heaters and high voltage supply are energized at all times

1.10 PA TUNE. The PA TUNE control is intended primarily for loading the transmitter to the antenna. However, for maximum receiver sensitivity, it must be set to the point which is correct for transmitting. If the transmitter section is not being operated, adjust the PA TUNE control for maximum receiver volume with the PA LOAD capacitor set at one turn back from maximum clockwise position. Otherwise, see TRANSMITTER TUNEUP section.

1.11 Transmitter Controls. The controls used exclusively in transmitting are: MIC GAIN, PA LOAD, METER Switch, and TUNE-OPER Switch. Their use is described in the TRANSMITTER TUNEUP section.

2. RECEIVER OPERATION

The SB-34 transceiver employs a 2.1 kc Collins mechanical filter to attain exceptional selectivity on both receive and transmit. The unit is designed to pass only that portion of the voice spectrum falling between 300 and 2400 cycles. Experience has shown that this bandwidth permits excellent intelligibility and still discriminates against interfering noise. Since the transceiver audio system and speaker is also carefully shaped to pass only 300 to 2400 cycles, the end result is reception similar to the quality of a conventional telephone. No adjustment of the transceiver will produce "high fidelity" reception in the normal sense. The SB-34 will, however, provide good communications under conditions of high noise and weak signals when conventional receivers with extended audio range and wide bandpass are completely unusable.

Considerable effort has been expended to prevent the receiver from overloading or blocking on strong signals. Since the volume control mainly affects the

RF section of the receiver rather than the audio circuits as is customary, the receiver is less likely to overload at low volume settings than at a high setting. Quite often interference from close-by stations can be completely eliminated by merely reducing the volume control setting. An automatic gain control system (AGC) is incorporated in the transceiver. It provides strong compression on signals when the audio output exceeds one-quarter watt (normal room volume). If more audio is required, as when operating mobile, turning the volume control into the upper half of its range increases the audio output to a maximum of three watts.

A few spurious responses (birdies) may be noted as the receiver is tuned through the various bands. With a normal antenna and in an average location, all of these responses will be below the level of a readable signal, with the exception of a single response at 7300.8 kc. Since this response is outside the amateur band, it should cause no inconvenience to the operator. It is, in fact, useful as a means of checking the dial accuracy, since it has the stability of the carrier oscillator and may be relied upon to be accurate as a frequency marker.

3. TRANSMITTER TUNEUP

NOTE

> Improper transmitter tuning can result in serious distortion and possibly operation outside the band. Improper adjustment of the MIC GAIN control can cause "flat-topping" and the generation of splatter and other spurious emissions. Make certain you understand the following instructions thoroughly before attempting to operate the transmitter.

Transmitter tuneup consists of adjusting the exciter, loading the power amplifier to the antenna, and setting the microphone gain control for optimum power output without distortion. The SB-34 has been carefully designed to minimize the possibility of improper operation due to faulty tuning procedures, and to make the tuneup process as simple and quick as possible.

The combination bandswitch and driver tuning, for instance, has been arranged to preclude the possibility of tuning up on incorrect frequencies. It is, however, possible to transmit a poor signal if the set is not correctly tuned. Take the time to memorize the following step-by-step procedure and your SB-34 will always transmit a clean, powerful signal that will be a credit to your station.

3.1 Power Amplifier and Driver Tuning. With the transceiver turned on, allow 30 seconds for warm-up of the transmitter tubes. Make certain an antenna

resonant to the band in use is connected. Set the controls as follows:

1. TUNE-OPER - to OPER.
2. DIAL CORRECT - center of range.
3. PITCH - off.
4. METER - Ip (in this function meter indicates PA plate current x 100 ma (0-500 ma).
5. Band Selector - to desired band.
6. Tuning Knob - to desired frequency.
7. PA TUNE - full counter-clockwise (max. capacity).
8. PA LOAD - full counter-clockwise (max. capacity).
9. MIC GAIN - full counter-clockwise (min. gain).

3.1.1 Adjust the bandselector knob within the arc of the band selected for maximum receiver noise.

3.1.2 Set the TUNE-OPER switch to the TUNE position. The receiver will "quiet" and the meter will indicate PA plate current.

3.1.3 Carefully re-adjust the band selector knob for maximum meter indication. This will occur at a setting very close to that which produced maximum receiver noise. One or more peaks may be evident if the band selector knob is tuned through the entire arc, but the correct setting will always be near the point of maximum receiver noise, and will always produce a much higher meter reading.

3.1.4 Turn the PA TUNE control clockwise until a sharp dip in meter indication occurs.

3.1.5 Set meter switch to ANT. In this function, the meter measures voltage across the antenna circuit and the amplitude of the readings will be dependent on the actual antenna circuit impedance. The meter, therefore, should be used only as an indicator of optimum transmitter tuning into the particular antenna.

3.1.6 Turn the PA LOAD control clockwise for maximum (peak) meter reading. NOTE: The PA LOAD control is a mica compression trimmer. This control rotates at least four full turns to go from minimum to maximum capacity.

3.1.7 Re-adjust PA TUNE control for maximum (peak) meter reading.

3.1.8 Repeat steps 3.1.6 and 3.1.7 until the meter reads maximum possible, with final adjustment being the PA TUNE control.

(If it is not possible to tune through a peak meter reading when adjusting the PA TUNE or PA LOAD control, the antenna system presents an input impedance

which is beyond the matching capabilities of the pi-network (40-100 ohms resistive) and the antenna system should be checked).

3.1.9 Switch meter back to Ip, note meter reading and return TUNE-OPER switch to OPER. Normal plate current should be 200 to 250 ma.

3.2 MIC GAIN Adjustment. Turn the METER switch to Ip position and the TUNE-OPER switch to TUNE long enough to note the meter reading.

With the transceiver properly tuned to a resonant antenna, the reading should be between 2.0 and 2.5. (In mobile operation with the engine off during tune-up, this reading may be slightly lower.) Return the TUNE-OPER switch to OPER, press the microphone button and speak a steady "Ahhh" into the microphone at the level and distance you intend to use when transmitting. Gradually turn the MIC GAIN control clockwise until the meter reading increases to approximately 1.5 if the maximum reading was 2.5; or 1.3 if the maximum reading was 2.0. This setting of the MIC GAIN control will ensure a strong transmitted signal without danger of overdriving.

NOTE

It is very important that the MIC GAIN control be correctly set. If it is too high, excessive distortion will be produced. On the other hand, too low a setting will result in low transmitter output. On-the-air reports should be taken with caution since they are subject to many inaccuracies.

V. THEORY OF OPERATION

The SB-34 single sideband transceiver is essentially bilateral. With the exception of the receiver RF amplifier and the high-level transmitting stages, the signal stages may amplify in either direction. During the receive function they amplify in one direction, on transmit they amplify in the opposite direction. The same tuned circuits are used for both transmitting and receiving. The various injection oscillators operate continuously, supplying the local oscillator signals to the proper mixer stages.

All transistors in the transceiver operate in the common emitter configuration except the receiver RF amplifier Q11. This stage operates common base.

A typical bilateral stage may be understood by referring to the 456 kc amplifier Q5-Q6 in the schematic diagram. With the microphone button released, the base bias resistor of Q5 is returned to a line which carries a +12-volt

(Receive mode)
potential. The transistor cannot conduct. The base bias resistor of Q6, however, is returned (through the volume control) to a line which is essentially ground potential with the microphone button released and Q6 is in conduction and able to amplify. Thus, with the microphone button up, a signal appearing at the mechanical filter will be amplified and delivered to IF transformer T2. With the microphone button pressed, the two bias-control lines are inverted in polarity so that Q6 is cut off and Q5 is able to conduct. Therefore, a signal appearing at T2 is amplified by Q5 and impressed on the filter. Similarly, the amplifying direction of the VFO mixer Q7-Q8, and the high-frequency mixer Q9-Q10 are controlled by the two bias control lines.

Unilateral stages that are required to operate only on receive or transmit are turned off when not needed by returning their base bias resistors to the appropriate bias control line. The transmitter tubes are disabled during receive by applying a high negative bias to their grids.

1. TRANSMIT FUNCTION

An audio signal from the microphone, controlled in amplitude by the MIC GAIN control, is amplified by the microphone amplifier Q4 and applied to the ring-balanced modulator CR3-7. Crystal oscillator Q12 operating at 456.38 kc, provides a carrier to the modulator. Carrier balance is obtained by a potentiometer and a trimmer capacitor. Double-sideband, suppressed-carrier output from the balanced modulator is amplified through T2 by the bilateral amplifier Q5-Q6. The amplified signal is then passed through the mechanical filter which suppresses the upper sideband.

Output from oscillator Q12 is also applied to frequency doubler CR8, and T-4. The doubled carrier frequency from this stage is then either doubled again or tripled by Q13. With the mode selector switch set at USB, the frequency is tripled; with the switch on LSB the frequency is doubled. Thus, on USB, a 2738.2 kc (456.38 x 6) signal appears at the output of T5. On LSB an 1825.5 kc (456.38 x 4) output appears at T5.

Doubler/tripler transformer T5 is connected in a ring with the mechanical filter, mixer CR9, and transformer T3 which is tuned to 2281.9 kc. With the mode selector in LSB, output from T5 is additively mixed with the lower-sideband signal from the filter to produce a lower sideband signal at 2281.9 kc. With the mode selector set on USB, the T5 output is subtractively mixed with the filter output to generate an upper-sideband signal, still at 2281.9 kc. Thus, the mode selector, by adjusting Q13 to either double or triple, determines the mode of the sideband signal. Since all of the frequencies involved are derived by a single oscillator, no shifting of carrier frequency can occur and no retuning is necessary when switching sidebands.

With the TUNE-OPER switch in TUNE position, a measured amount of carrier signal is inserted in the DC load resistor of mixer CR9 for transmitter tune-up purposes only. NOTE: Power output measured in the TUNE position with a power meter is not indicative of the PEP output of the transmitter.

The 2281.9 kc upper or lower sideband output from T3 is applied to VFO mixer Q7-Q8. Also applied to this mixer is an injection signal which is tunable from 5456.9 kc to 5706.9 kc. This injection is generated by VFO Q15 and isolated from the load by VFO buffer Q14. Tunable IF transformer T6, connected to the output of VFO mixer Q7-Q8, tunes the frequency range 3175 through 3425 kc. This frequency range is the result of subtractively mixing the incoming 2281.9 kc sideband signal with the VFO injection. Transformer T6 is gang-tuned with the VFO and thus is always accurately tuned to the desired frequency.

The 3175 kc to 3425 kc sideband signal from Q7-Q8 is applied to high-frequency mixer Q9-Q10. Also applied to this mixer is an injection from high frequency crystal oscillator Q19. The frequency generated by this oscillator may be 7200, 10475, 17525, or 24625 kc depending upon the position of the bandswitch. Here again, the 3175-3425 kc incoming signal is subtractively mixed to produce the final output frequency. Output from mixer Q9-Q10 appears across tuner coil L2. The resonant frequency of L2 is controlled by a large variable capacitor and a special slug which penetrates into the coil an amount depending upon the setting of the bandswitch. The large variable capacitor is mechanically linked to the bandswitch through a Geneva movement so that rotating the capacitor shaft tunes the coil through a limited range bracketing the selected operating band. Changing the bandswitch to the next band tunes a limited range bracketing this band, etc. On 80 meters, the slug is almost fully penetrated into the coil and the capacitor is near maximum capacity. On 40 and 20 meters, the slug and capacitor are at near mid-range, and on 15 meters the slug is fully withdrawn and the capacitor is near minimum. By this unique method of tuning and bandswitching, the Q and inductance/capacitance ratio of L2 and the variable capacitor are near optimum on all bands, and the resonant impedance remains essentially constant across the entire tuning range. This tuning is ganged with, and duplicated in, antenna coil L3 and driver coil L7 which results in exciter train tuning with only one control.

The single-sideband suppressed-carrier final output signal from L2 is applied to the grid of transmitter driver V1 where it is amplified, and appears across L7. A low-impedance winding on L7 couples the signal to the paralleled grids of power amplifier V2 and V3. Neutralization of the power amplifier is accomplished by feeding back a small amount of the output through Cn to the top of L7 with the low-impedance winding providing the necessary phase reversal.

Final output from V2 and V3 is fed to a pi-section network consisting of L9 and the PA TUNE and PA LOAD capacitors. A section of the bandswitch adjusts the

inductance of L9 to the correct value for each band, and also adds fixed amounts of capacity to both the PA LOAD and PA TUNE capacitors on 80 meters.

2. RECEIVE FUNCTION

With the microphone button released, a signal from the antenna is loosely coupled from the transmitter pi-section net to the top of L3. Diodes CR14 and CR15, across L3 conduct only when extremely strong signals are present and do not otherwise affect the circuit. The signal at L3 is coupled to the emitter of Q11 which operates as a common-base amplifier. The amplified signal from Q11 is applied to high-frequency mixer Q9-Q10 through L2. With injection from Q19, this stage converts the signal to a frequency within the range 3175-3425 kc. The converted signal is then mixed by Q7 and Q8 to 2281.9 kc with injection from the VFO Q14 and Q15. The converted signal is finally mixed by diode CR9 to the 456.38 reference frequency in a manner exactly opposite to that described for this stage during the transmit function. Output from the filter is then amplified by Q5 and Q6 and coupled through T2 to the ring modulator CR3-CR7.

With BFO injection from the carrier oscillator, the ring modulator now functions as a detector, and produces an audio output which is applied to the base of Q2. Output is taken from the collector and coupled to audio driver Q1. This stage, in turn, drives the audio power amplifier Q20 which increases the signal to speaker level.

The VOLUME control sets the gain of the high-frequency mixer, the 456 kc amplifier and, to a small extent, the first audio amplifier, Q2. Other signal stages operate at full gain except in the presence of AGC action.

RF amplifier Q11 and IF amplifier Q5-Q6 are gain controlled by AGC amplifier Q3. An audio signal appearing across the speaker terminal causes Q3 to conduct heavily. The voltage at its collector is normally close to that of the supply, +12 volts. When Q3 conducts, however, the collector potential falls rapidly and charges the 250-mfd capacitor (connected between collector and the 12-volt bus) to some value less than 12 volts. This AGC voltage is connected to the emitters of the RF amplifier and the 456 kc amplifier, and as the AGC voltage falls toward ground potential, the gains of these stages are reduced until the audio output is stabilized. The AGC action is proportioned such that the RF amplifier becomes largely cut off in the presence of even moderate signals so that following stages are protected from signal overload. If the signal fades, causing the audio output to drop, Q3 conducts less and the 250-mfd capacitor slowly discharges toward the +12-volt potential, causing the stages gains to be restored as necessary to maintain the audio level.

When the VOLUME control approaches the fully clockwise position, diode CR1, connected to the base of Q3, begins to limit the amount of audio applied for AGC action. With this occuring, more audio output is produced for a given amount of AGC. Finally, with the volume control fully clockwise, the base of Q3 is clamped off and full audio output is produced.

Diode CR2, in the collector of Q3, conducts when the unit is switched to transmit. This conduction charges the 250 mfd capacitor to the 12-volt potential so that when the set is switched back to receive, full receiver gain is instantly available.

3. KEYING CIRCUIT

Two transistors, Q16 and Q17, perform the functions necessary to switch the transceiver from receive to transmit, thus eliminating the conventional relay. The base of Q16 is coupled through a current limiting resistor to the cathode of driver tube V1. With the microphone button released, V1 draws no cathode current and its cathode is at ground potential. Q16, therefore, is cut off and the potential at its collector is +12 volts. This potential is supplied to the control line that requires +12 volts on receive. Also, the collector potential at Q16 is applied to the base of Q17 causing this transistor to conduct to saturation. Its collector potential, therefore, is essentially grounded. The control line requiring ground potential on receive is connected to the collector of Q17.

When the microphone button is pressed, the high negative bias on driver tube V1 is removed and the stage conducts. The cathode potential of V1 rises to approximately +6 volts and, with this voltage applied to the base, transistor Q16 conducts to saturation. The control line that was +12 volts on receive is now at ground potential. In addition, since the potential on the base of Q17 is removed, this stage cuts off and the control line that was grounded on receive is now +12 volts.

4. POWER SUPPLY

The SB-34 contains a power supply designed to operate from either 117-volts AC or 12-volts DC (negative ground). Inserting the appropriate power cord into the rear-panel receptacle makes the necessary connections to operate the supply in either mode.

With DC operation, transistors Q21 and Q22 are connected as a common-emitter power oscillator. Starting bias for this oscillator is obtained from a small resistor and the heater current of driver tube V1. All of the transmitter-tube heaters and input voltage to the oscillator are applied through the XMTR switch so that the receiver portion of the transceiver may be operated with reduced

ower consumption. A high-voltage winding of T7 is connected to a voltage tripler circuit CR17, CR18 and CR19 to supply approximately +450 volts to the transmitter tubes and +150 volts to the screen grids of V2 and V3. Another small secondary winding is half-wave rectified by CR20 to supply negative bias to the transmitter tubes.

With 117-volt AC operation, T7 is energized by a second primary winding. The feedback and collector windings of the transformer are connected essentially in series and full-wave rectified by the collector-base diodes of Q21 and Q22 to provide a high-current +12 volts output. This voltage is used to operate the transistorized stages and operate the transmitter tube heaters. The high-voltage and bias systems operate as described above. The XMTR switch, in this mode of operation is not connected; the transmitter tube heaters are energized at all times.

A special regulator circuit is provided to stabilize the voltage to the VFO, Q14 and Q15. Regulator Q18 operates as a shunt regulator across the +12 volt bus to provide an output of +7.0 volts. The current to the base of Q18 is determined by the current flow through zener diode CR10, and since this zener diode in itself is not a perfect regulator, the output voltage from Q18 would normally vary slightly as the supply voltage changed. To overcome this variation, a small variable resistor is inserted in the series-dropping resistor line to the regulator transistor. The effect of this variable resistor is to insert an additional amount of base current to the transistor to offset the slight change that occurs in the zener diode due to supply-voltage changes. Thus, with proper adjustment of the resistor, regulation becomes perfect for input supply voltages of 11.5 to 15.0 volts.

5. PITCH CONTROL

The purpose of the PITCH control is to permit slight adjustment in receiver frequency with respect to the transmitting frequency. The control may be switched in or out as desired. A small silicon diode, CR11, is connected between the "hot" end of the VFO coil L5 and a voltage divider network which may be adjusted to a value between the regulated voltage (+7 volts) and ground. The diode is connected so that a reverse bias is applied and therefore appears as a small capacitor, the actual value of capacity being variable depending on the amount of reverse bias applied.

The voltage divider network supplying bias to the diode contains, in one leg, the DIAL CORRECT potentiometer. This leg is active on both transmit and receive. The other leg of the network is divided into two sections, one operating on transmit, the other on receive. On transmit, the leg consists of a 470-ohm resistor and diode CR12 which is arranged to conduct only on transmit. On receive, the leg consists of either an adjustable resistor (when the PITCH

switch is OFF) or the PITCH control (when the PITCH switch is on) and diode CR13 which conducts only on receive.

The overall effect of the PITCH control network is to permit a slight variation in VFO frequency on both transmit and receive by the DIAL CORRECT control, and a variation on receive only by the PITCH control. The adjustable resistor, activated when the PITCH switch is off, is factory set so that the VFO frequency on receive is exactly the same as on transmit.

VI. TROUBLESHOOTING

The SB-34 transceiver has been carefully aligned and tested at the factory, and all adjustments that might become misaligned from the effects of vibration and temperature cycling have been securely locked in place.

Problems that might possibly arise, and their detection and correction, are included in the following paragraphs.

1. CARRIER BALANCE

The SB-34 is designed to maintain carrier suppression of at least 50 db below full output for extended periods of time. If for any reason excessive carrier is present, the carrier balance potentiometer on the rear panel should be readjusted. The most accurate method for doing this requires a fairly sensitive vacuum-tube RF voltmeter, such as the Hewlett-Packard HP-410B, or equivalent, connected across the antenna terminals. With the MIC GAIN control set fully counter-clockwise, and the microphone button pressed, the residual carrier, as measured by the voltmeter, should be nulled to a value of 0.2 volts rms, or less, by use of the carrier balance potentiometer. Check operation on both sidebands since there may be a slight difference in carrier between the two modes. Any difference should be averaged out by the potentiometer. If it is not possible to reduce the carrier to a reading of 0.2 volts with the potentiometer alone, remove the set from the cabinet, and readjust the carrier balance trimmer (see top-view layout chart). The trimmer and the potentiometer interact somewhat so that several cycles of adjustment may be required. Note: T2 adjustment can also affect carrier balance.

2. LOW TRANSMITTER OUTPUT

Low transmitter output generally indicates weak tubes. If the off-resonance plate current of the power amplifier stage becomes less than 200 ma, as indicated on the front-panel meter, either the driver or power amplifier tubes may require replacement. If the power amplifier tubes are replaced, reneutralization may be necessary. The neutralizing capacitor (Cn) must be adjusted with an insulated alignment tool. Proper neutralization is indicated

when maximum output and minimum plate current occur with the same setting of the PA TUNE control. The adjustment should be made with the set tuned for 15-meter operation. (See Section 10.1 for Neutralizing Method.)

3. LOW RECEIVER SENSITIVITY

Since the receive portion of the transceiver is fully transistorized, no loss in sensitivity should be experienced with age. If the receiver seems to be lacking in sensitivity, the RF trimmer and slug (see layout charts) may require touch-up. Make certain that the transmitter is properly tuned to the antenna before making the adjustment. The slug may be reached through the side of the chassis and requires a long screwdriver, completely non-metallic.

Low audio output or distortion may also be traced to leaky or shorted electrolytic capacitors in the audio portion of the receiver or transmitter. These will usually cause abnormal voltage readings at the various stages. Refer to the voltage chart.

VII. ALIGNMENT

WARNING

> Dangerous high voltage is present in the equipment whenever the unit is turned on. The high-voltage filter capacitors remain charged at all times and can cause fatal shock under certain conditions. Allow at least five minutes after the unit is turned off for the filter capacitors to discharge. Always remove the line plug from the outlet when servicing the set.

1. EQUIPMENT REQUIRED

For correct alignment, an accurate vacuum-tube RF voltmeter such as the Hewlett-Packard HP-410B, a calibrated audio voltmeter, and a well-calibrated RF signal generator such as the Measurements Model 65B are required. Do not attempt alignment unless accurate equipment is available.

2. ALIGNMENT PROCEDURES

NOTE: Refer to layout charts for location of various components and test points. Use test probes with caution; an accidental short will usually cause permanent damage to transistors.

2.1 Carrier Oscillator. Connect the VTVM to the center arm of the carrier-balance potentiometer, R25. A reading of 1 volt rms or more indicates correct oscillator operation.

2.2 Doubler and Doubler/Tripler Alignment. Connect a VTVM to the cathode of CR9. A reading of 0.5 to 0.6 volts indicates correct operation. Test with USB-LSB switch in both positions. If reading is low, align both slugs of T4 for maximum output. Switch to USB and align both slugs of T5 for best output. Switch to LSB and adjust the two X2 ADJUST trimmers for maximum. If readings are high, detune the bottom slug of T4 slightly until reading is correct. If only the LSB reading is high, detune one of the X2 ADJUST trimmers slightly.

2.3 VFO Alignment. Faulty VFO operation is indicated when dial readings cannot be corrected by the DIAL CORRECT knob, or no receiver operation is obtained on any band. Test for VFO oscillation by connecting the VTVM to the rear lug of the small 3-gang tuning capacitor. A reading of approximately 1.0 volt rms is normal. Test the VFO buffer by connecting the VTVM to the collector of Q14. Adjust the VFO buffer coil L4 for a reading of 0.12 volts rms.

To adjust the VFO frequency, set the DIAL CORRECT knob with pointer up and the PITCH switch to OFF. Tune the receiver to a signal of an accurate, known frequency (or use 100-kc calibrator) and adjust the VFO trimmer, C-54 until the signal is zero beat at the correct dial reading.

2.4 Receiver Zero Adjustment. Loosely couple the antenna lead of a stable full-coverage receiver to L4. Tune the receiver in the range 5.50 - 5.75 mc until the VFO signal is heard. Press the microphone button and accurately zero beat the signal on the receiver. Release the microphone button and adjust the VFO ZERO potentiometer R58 until the signal is again zero beat. Press the button several times and check to see that no detectable shift in VFO frequency occurs between receive and transmit.

NOTE: This adjustment will only hold across the dial if the VFO is properly aligned in accordance with paragraph 2.3 above.

2.5 Crystal Oscillator Alignment. Connect the VTVM to the emitter of either Q9 or Q10. Set the bandswitch to 15 meters. Adjust the slug of L6 for a meter reading of 0.25 volts rms. If this reading cannot be obtained, a reading between 0.2 and 0.3 volts is satisfactory. Now set the bandswitch to 20 meters and adjust the rear crystal trimmer (next to bandswitch) for a meter reading of 0.25 volts. Next, set the bandswitch to 40 meters and adjust the center trimmer for 0.25 volts. Finally, set the bandswitch to 80 meters and adjust the forward trimmer for 0.25 volts.

2.6 Receive RF Amplifier Alignment. Set the bandswitch to 15 meters and adjust pointer to the center of the 15-meter arc. Connect a signal generator to the antenna jack J5 and set for operation at 21.35 mc unmodulated. Reduce the attenuator as required so that an audio output signal of less than 0.25 volts (measured on the rear-panel speaker terminals) is obtained at full volume

control setting. Adjust the PA TUNE and PA LOAD controls for maximum audio output. Then adjust the center trimmer C90-B of the large 3-gang capacitor for maximum audio output. Then set the transceiver to receive on 3.80 mc and adjust the signal generator to 3.80 mc. Reset PA TUNE and PA LOAD controls for maximum audio output. With the attenuator set for an audio output of less than 0.25 volts, set the bandswitch knob index to a point 1/4" from the clockwise edge of the 80-meter arc. Adjust the center slug (L3) on the slug rack for maximum audio output. Use a long, non-metallic screwdriver for this adjustment.

2.7 Transmitter Bias Adjustment. Key transmitter with no drive, METER switch in Ip position. Adjust bias control, located in the upper right corner of the tube compartment, for a meter reading of 100 ma. This sets the final amplifier bias.

2.8 T2 Alignment. Set the transceiver to transmit on 3.80 mc. Connect a suitable 50-ohm dummy load to the antenna jack J5. Also connect the VTVM to the antenna jack. Connect a two-tone test signal into the microphone jack J1 and with the microphone button pressed, tune the transmitter controls for maximum power output with MIC GAIN control advanced slightly. Then reduce the MIC GAIN setting until the output is about 30 volts. Adjust T2 (one slug) for maximum output.

9 T3 Alignment. With the conditions set up for Step 2.8, adjust both slugs of T3 for maximum output.

2.10 T6 Alignment. With the conditions set up for Step 2.8, tune the transceiver to 3.90 mc. Repeak the bandswitch knob, the PA TUNE control and the PA LOAD control for maximum output. Then adjust both slugs of T6 for maximum output.

2.11 High-Frequency Mixer Alignment and Transmitter Drive Adjustment. With the conditions set up as in Step 2.8, set the transceiver to transmit at 21.35 mc and adjust the transmitter controls for maximum output. Set the bandswitch knob to the center of the 15-meter arc. With the MIC GAIN control set for an output of about 45.0 volts, adjust the forward trimmer, C90-A, of the large 3-gang capacitor for maximum output. Also adjust the rear trimmer, C90-C, for maximum output. If a large change in this trimmer is noted, it may be necessary to re-neutralize the power amplifier.

2.12 Transmitter Final Amplifier Neutralization. With conditions set up as outlined in Step 2.8, advance the MIC GAIN control until flat-topping occurs. Adjust the neutralizing capacitor C86 until maximum output and minimum plate current occur at the same setting of the PA TUNE control. There is some interaction between the neutralizing capacitor C86 and the drive trimmer C90C;

therefore C90C (rearmost trimmer) should be adjusted for maximum output per Step 2.11 before attempting to adjust the neutralizing capacitor.

2.13 Now set the transceiver to transmit at 3.80 mc and adjust controls for maximum output. Set the MIC GAIN control for about 30-volts output. Set the bandswitch knob index at a point 1/4" from the clockwise edge of the 80-meter arc. Adjust the front slug (L2) of the slug rack for maximum output. Also adjust the rear slug for maximum output.

2.14 Finally, set the transceiver to transmit at 7.20 mc and adjust controls for maximum output, release the microphone button and see that maximum receiver noise occurs at the same setting of the bandswitch knob as transmitter maximum output. If not, adjust the rear slug (L7) very slightly until the two settings are very nearly the same. Check 80-meter operation again and see that the bandswitch knob settings for maximum receiver noise and transmitter output are very nearly the same.

2.15 L10 Alignment. This adjustment reduces the spurious radiation of a signal at 24,625 kc, the frequency of the crystal oscillator when operating on 15 meters. Set for transmit on 21.35 mc and adjust for maximum transmitter output. Then set the MIC GAIN control fully counter-clockwise and adjust the VTVM to read the residual output signal. Slowly turn the PA TUNE control clockwise until a small peak shows on the VTVM. Adjust the slug of L10 for minimum reading. The final reading should be less than 1.0 volt rms. Return the PA TUNE control to the setting for maximum 15-meter output.

2.16 Carrier Balance. After completing Step 2.15, again reduce the MIC GAIN setting to zero. Alternately adjust the Carrier Balance potentiometer R25 and the Carrier Balance trimmer C23 for minimum output. It should be possible to null the carrier to a VTVM reading of less than 0.2 volt with the USB-LSB switch in either position. This completes the alignment procedure. Incorrect adjustment of T2 can affect carrier balance.

2.17 Voltage Regulator Adjustment. R42, the voltage regulator adjustment, has been carefully set at the factory and should not normally be adjusted in the field. If replacement of either Q18 or CR10 necessitates re-adjustment, the following procedure should be used.

Note: In addition to the test equipment listed on the preceeding page, a variac will be required for accurate voltage regulator adjustment.

Tune the receiver to a calibrator signal or other stable source. Vary the AC input line voltage between 100 and 120 volts while adjusting R42 for a steady signal. The voltage regulator is properly adjusted when the signal stability is unaffected by the line voltage fluctuations.

3.2 PRELIMINARY CHECKOUT

Control settings:

Volume----------Fully CCW
Pitch Switch----------Off
Pitch Control----------Center of Range
Dial Correct----------Center of Range
Mic Gain----------Fully CCW
PA Load----------Fully CCW
PA Tune----------Fully CCW
USB/LSB----------USB
Tune/Operate Sw---------Operate
Meter Switch----------Ip

1. Plug unit in to variac and apply power - adjust variac to 120 vac.
2. Turn volume control on. Total line current should not exceed .7 amp.
3. Advance colume control to full CW. Adjust bandswitch for a noise peak on 40 meter band.
4. Connect dummy load, scope, VTVM, and two tone test signal.
5. Key the transmitter
6. Advance mic gain halfway and tune transmitter as described in "Operation" section.
7. This completes the preliminary checkout.

3.2J

1) If total line current exceeds .7 amps, a short circuit probably exists. See trouble shooting chart "Excessive Line Current". If no short exists, check to see that the transmitter is not being keyed by either front panel controls, grounded - 70V line, or faulty keyers.

2) If no noise peak is obtainable, see trouble shooting chart "No Noise Peak". The audio curcuit may be quickly checked by placing one finger on the base of Q-2 and briefly touching your other hand to the collector of Q-20 (audio power amp). A loud squeal will result if the circuit is operating.

3) If the transmitter fails to key, refer to the trouble shooting chart "Transmitter Will Not Key". A meter indication of 100 ma will indicate proper idle current of the PA Tubes.

4) If the plate current can not be peaked by the exciter tune or no increase is evident as mic gain is advanced, refer to trouble shooting chart. If the receiver has already been checked and is operating properly, the possibility of faulty oscillators may be eliminated. The voltages in the trouble shooting chart are approximate and are measured with bandswitch control on receive noise peak.

5) Once the preliminary checkout has been completed, it may be assumed that the unit has been cleared of any Basic troubles. Specific troubles will be covered as the alignment procedure is performed. It is recommended that the receiver alignment is performed first even if the complaint is in the transmitter. This will insure correct adjustment of the various injection oscillators and if transformers which is necessary for proper transmitter alignment.

3.2.2 TROUBLESHOOTING GUIDE

Complaint or Symptom	Probable Cause	Component
Excessive Line Current	B+ short-Check to see that HV Test point is 50 kΩ in 10 seconds	
	Power inverter short	Q 21, Q22-C67,C68
No Noise Peak	456 OSC-Testpoint (1) should be at least 1.0 volts rms	Y 1, Q-12
	Doubler-Doubler/Tripler-Test point (2) should be at least .5 volts	Check alignment, Q-13, CR 8
	VFO-Test point (3) should be at least .12 volts	Q15, Q14 L-4 Misaligned
	HF OSC - Testpoint (4) should be at least .2 Volts	Q19, L6 misaligned. Poor ground on pc Board
	Keyers open-Test points (5) & (6) should be: (5) .2 VDC or less (6) 12 VDC Minimum	Q 16, Q 17
	Shorted Mixer Transistor	Q7, Q8, Q9, Q10
	Shorted 456 amp.	Q5, Q6
	Defective audio ckt	Q2, Q1, Q20 (Q-4 shorted)
No noise peak on one Band	No High Freq. oscillator injection on the applicable Band Tp(4)	Y2, Y3, Y4, Y5 Alignment of C80, C81, C82 or L6
Transmitter will not key	Defective Keyer	Q 16
	V1 not conducting/70V Line not grounded	V 1 Microphone
	No Bt to V-1	B + supply
Transmitter Keys but will not tune	No RF Drive	TP 12,13,14,10,11.
	TP 10: MIC amp inoperative-check for a change from 0-.2 VAC as mic gain is rotated from min. to max.	
	TP 11: 456 kc amp inoperative-check for a change from 0-2 vac as mic gain is rotated from min. to max.	Q-5

Complaint or Sympton	Probable Cause	Component
Transmitter keys, but will not tune	TP 12: VFO Mixer inop - Check for a change from 0-.25 vac as mic gain is rotated from min. to max.	Q 7
	TP 13: HF Mixer inoperative-Check for a change from .2 to 1.8 vac as mic gain is rotated from min. to max.	Q 9
	TP 14: Driver inoperative -set mic gain control for max-Check for up to 15 vac R-F	V 1, C-90C, L 7, L14
	OutPut Connector: PA ckt inoperative with mic gain set at max. check for up to 54 VAC R-F	V2,V3, C78, C76, L9, S7

3.3 ALIGNMENT SECTION

If, in following this procedure, a specified voltage can not be obtained or a condition satisfied, refer to that section of the "Alignment Trouble Shooting Chart" which corresponds to the number preceeding the alignment step. Check to see that the controls are set as follows:

Volume----------Fully CCW
Pitch Switch----------Off
Pitch Control----------Center of Range
Dial Correct----------Center of Range
Mic Gain----------Fully CCW
PA Load----------Fully CCW
PA Tune----------Fully CCW
USB/LSB Switch----------USB
Cal Switch----------Cal
xmtr Switch----------xmtr
Tune/Oper----------Oper
Meter Switch----------Ip

Set internal adjustments for the following positions only if previous alignment has been attempted or the unit has been tampered with:

Bias pot (R-8L) - Fully CCW (Located inside PA cavity)
Regulator control (R-42) - Center of range (Located on left rail)
Receiver zero pot (R-58) - Center of Range (Under chassis below VFO Board)
Neutralizing cap (C-86) - Screw end to be 5/8" from mounting surface
Tuner slug screws - Screw end 1/8" from edge of rack
24 mc trap (L-10) - Slug even with edge of terminal ring

3.3.1 PROCEDURE

3.3.1.0 VOLTAGE TESTS - Turn volume control to ON.
3.3.1.1 Measure voltage at Red Bus on Tuner Board. With input voltage, set at 120 volts, Red Bus voltage shall be 11 vdc minimum.
3.3.1.2 Measure voltage at Gray Bus on Tuner Board. Shall be 11 vdc minimum.
3.3.1.3 Measure voltage at Blue Bus on Tuner Board. Shall be 0.2 vdc maximum.
3.3.1.4 Measure voltage at Purple Lead on Tuner Board. Shall be -70 v minimum.
3.3.1.5 Measure voltage on Plates of PA Tubes. Shall be 480 vdc minimum.

3.3.2.0 RECEIVER ALIGNMENT - VTVM refers to HP-410B using R-F probe.
3.3.2.1 Connect VTVM to TP 1 (center of carrier balance pot). Voltage shall be 1. volt minimum.
3.3.2.2 Connect VTVM to collector of Q-13. Align both slugs of T4 for maximum reading. Make sure that slugs are on outside of coils.
3.3.2.3 Connect VTVM to TP 2 (IF Board). With USB/LSB switch in USB position, align both slugs to T-5 for maximum reading. Then switch to LSB and align both mica compression trimmers (C32 & C33) for maximum output. If the reading with the switch in LSB exceeds .5 volts, screw the bottom slug of T-4 into the coil until a reading of .5 volts is obtained. Place switch in USB position and note the reading. If this reading is less than .6 volts, screw the bottom slug of T-4 out of the coil until .6 volts is obtained. Switch to LSB and adjust C-33 until a reading of .5 volts is obtained. If ~~the~~ This reading exceeds

.6 volts, screw the top slug of T-5 out of the coil until .6 volts is obtained. (If this adjustment is required, retune the mica compression trimmers with the switch in LSB, for maximum output). Final output voltages should be .6 volts for USB and .5 volts for LSB. OK

3.3.2.4 Set the tuning dial to 7.15 mc (40 meters). Connect the VTVM to the rear stator lug of the small 3 gang capacitor (C48-C). A reading of .5 to .8 volts indicates correct VFO operation.

3.3.2.5 Connect the VTVM to the rear inboard lug of L-4 (TP 3). Screw L-4 slug to the clock-wise limit and then counter-clock-wise until a reading of .12 volts is obtained.

NOTE: In units with chassis # 12 or below, this reading may only decrease to .4 volts.

3.3.2.6 Loosely couple the antenna of monitor receiver to the VFO output. (Recommend clamping alligator clip over C-43). Check to see that dial reading of unit under test reads between 7.15 and 7.2. Adjust the monitor receiver until a beat note is heard (approximately 200 cps). Vary the line input variac between 95-120 vac. Adjust the regulator control (R-42) so that the beat note remains the same as the variac is swung from 95-120 vac.

3.3.2.7 Put the set in tune position. If the beat note changes, adjust the monitor receiver as required to return it to 200 cps. Check to see that the pitch switch is off. Unkey the transmitter and adjust the receiver zero pot (R-59) until the beat note is the same as with the transmitter keyed. Key and unkey the transmitter several times to assure that beat note remains the same.

3.3.2.8 With the transmitter unkeyed, turn the pitch on. See that the pitch control will vary the beat note at least 300 cps above and below the note obtained with the transmitter keyed. Turn off pitch switch.

3.3.2.9 With the transmitter keyed, test the dial correct control. It should be possible to vary the beat note at least 1500 cycles above and below the note obtained with the dial correct knob centered. Remove the monitor receiver hookup. Unkey the transmitter.

3.3.2.10 Connect VTVM to TP 4 on the high frequency oscillator board. Turn the bandswitch to 15 meters. Adjust coil slug (L-6) for a meter reading of .24 volts. (NOTE: The slug will usually tune out of the coil for this reading in units with chassis numbered 20 and above - refer to modification section). Turn the bandswitch to 20m and back to 15m several times to make sure that the oscillator starts reliably.

3.3.2.11 Turn the bandswitch to 20 meters and adjust C-80 trimmer (located in PA cavity) for a reading of .24 volts.

3.3.2.12 Turn the bandswitch to 40 meters and adjust C-81 for a reading of .24 volts.

3.3.2.13 Turn the bandswitch to 80 meters and adjust C-82 for .24 volts. Check to see that the oscillator starts reliably on all bands and that output on all bands is .24 volts. Remove the VTVM leads.

.6 volts, screw the top slug of T-5 out of the coil until .6 volts is obtained. (If this adjustment is required, retune the mica compression trimmers with the switch in LSB, for maximum output). Final output voltages should be .6 volts for USB and .5 volts for LSB.

3.3.2.4 Set the tuning dial to 7.15 mc (40 meters). Connect the VTVM to the rear stator lug of the small 3 gang capacitor (C48-C). A reading of .5 to .8 volts indicates correct VFO operation.

3.3.2.5 Connect the VTVM to the rear inboard lug of L-4 (TP 3). Screw L-4 slug to the clock-wise limit and then counter-clock-wise until a reading of .12 volts is obtained.

NOTE: In units with chassis # 12 or below, this reading may only decrease to .4 volts.

3.3.2.6 Loosely couple the antenna of monitor receiver to the VFO output. (Recommend clamping alligator clip over C-43). Check to see that dial reading of unit under test reads between 7.15 and 7.2. Adjust the monitor receiver until a beat note is heard (approximately 200 cps). Vary the line input variac between 95-120 vac. Adjust the regulator control (R-42) so that the beat note remains the same as the variac is swung from 95-120 vac.

3.3.2.7 Put the set in tune position. If the beat note changes, adjust the monitor receiver as required to return it to 200 cps. Check to see that the pitch switch is off. Unkey the transmitter and adjust the receiver zero pot (R-59) until the beat note is the same as with the transmitter keyed. Key and unkey the transmitter several times to assure that beat note remains the same.

3.3.2.8 With the transmitter unkeyed, turn the pitch on. See that the pitch control will vary the beat note at least 300 cps above and below the note obtained with the transmitter keyed. Turn off pitch switch.

3.3.2.9 With the transmitter keyed, test the dial correct control. It should be possible to vary the beat note at least 1500 cycles above and below the note obtained with the dial correct knob centered. Remove the monitor receiver hookup. Unkey the transmitter.

3.3.2.10 Connect VTVM to TP 4 on the high frequency oscillator board. Turn the bandswitch to 15 meters. Adjust coil slug (L-6) for a meter reading of .24 volts. (NOTE: The slug will usually tune out of the coil for this reading in units with chassis numbered 20 and above - refer to modification section). Turn the bandswitch to 20m and back to 15m several times to make sure that the oscillator starts reliably.

3.3.2.11 Turn the bandswitch to 20 meters and adjust C-80 trimmer (located in PA cavity) for a reading of .24 volts.

3.3.2.12 Turn the bandswitch to 40 meters and adjust C-81 for a reading of .24 volts.

3.3.2.13 Turn the bandswitch to 80 meters and adjust C-82 for .24 volts. Check to see that the oscillator starts reliably on all bands and that output on all bands is .24 volts. Remove the VTVM leads.

14 Connect the SIGNAL GENERATOR leads to the antenna jack and an AC voltmeter to the external speaker terminals on the rear panel. Set the bandswitch knob to the center of the 15 meter arc. Set the tuning dial to 21.30 mc. Tune the signal generator (with modulation off) near 21.30 mc until a beat note is heard. Adjust signal generator attenuator for an audio output meter reading of .2 volts or less with volume control fully clock-wise. Adjust the PA tune and PA load controls for maximum audio output. Peak the front and center trimmers on the large 3 gang capacitor (C 90 A & B) for maximum output. Reduce the generator output as required to keep audio meter reading below .2 vac. Tune both slugs of T-3 and T-6 and the single slug of T-2 for maximum output. Final audio output shall be 1 volt for an input of 1 microvolt. If the required sensitivity is achieved, proceed to 3.3.2.15.

NOTE: The following readings are approximate and should be used only as a general guide in locating a weak stage. The generator used had 50 OHMS output and a .03 MFD isolating capacitor on the signal input line.

3.3.2.14.1 Connect signal generator to the base of Q-6. Adjust generator around 456 kc until a beat note is heard. With 15 microvolts ± 30% input at this point, .5 volts audio should appear at the speaker output.

3.3.2.14.2 Connect signal generator to the base of Q-8. Adjust generator between 3175 kc and 3425 kc until a beat note is heard. With 7.5 microvolts ± 40% input, .5 volts audio should appear at the speaker output terminals.

3.3.2.14.3 Connect signal generator to the base of Q- 10. Adjust generator to dial frequency until a beat note is heard. With 1.1 microvolts, ± 40% input, 1 volt should appear at the speaker output terminals.

3.3.2.14.4 Connect signal generator to antenna input jack. Adjust generator to dial frequency until a beat note is heard. With 1 microvolt input, 1 volt should appear at speaker output terminals.

3.3.2.15 Set bandswitch to 80 meters with index 1/8" from the clock-wise edge of the 80 meter arc. Set the tuning dial to 3.80 mc. Adjust the signal gererator near 3.8 mc until a beat note is heard. Reduce attenuator as required to keep audio down to .2 volts. Adjust the center and front slugs on the tuner board (L-2 and L-3) for maximum audio output. Adjust PA load and PA tune controls for maximum output. Final audio output shall be 1.5 volts for an input of 1 microvolt.

3.3.2.16 Check 40 meter receiver operation by tuning set and signal generator to 7.10 mc and adjusting bandswitch, PA load and PA tune controls for maximum output. Final audio output shall be 1 volt for an input of 1. microvolt.

3.3.2.17 Check 20 meter receiver operation by tuning set and signal generator to 14.2 mc and adjusting bandswitch, PA load and PA tune controls for maximum output. Final audio output shall be 1.5 volts for an input of 1 microvolt.

3.3.2.18 This completes receiver alignment. Remove signal generator and audio output meter leads.

3.3.3.0 TRANSMITTER ALIGNMENT - Readings taken with HP-410B

3.3.3.1 Connect dummy load to antenna jack. Connect VTVM across antenna jack. Adjust scope for clean two-tone output @ .015 volts. Set frequency to 21.30 mc. Set bandswitch to 15 meters and adjust to the point of maximum receiver noise.

3.3.3.2 Key the transmitter. With the mic gain control fully CCW, adjust the bias pot (R-81) for a total line current of 1.2 amps (plate current meter should read between 1. and 1.5).

3.3.3.3 Advance the mic gain control to mid scale, <u>set PA tune CCW</u>, and adjust the rear trimmer on the large 3 gang capacitor (C-40c) for maximum front panel meter reading. If the scope pattern shows signs of self oscillation at this point, adjust the neutralizing capacitor (C-86) as required to prevent it.

3.3.3.4 Adjust the PA tune and PA load controls for maximum transmitter output, and advance the MIC gain control as required to keep the transmitter scope pattern at the point of flat topping. (NOTE: always approach PA resonance from the CCW position. The output obtained at the extreme CW position of the PA tune control is incorrect). If signs of instability show, readjust the neutralizing cap as required. Adjust <u>slightly</u> the front trimmer of the large 3 gang capacitor (C-90A) for maximum output. After the above mentioned adjustments have been completed, with the mic gain set just at the point of flat-topping, the VTVM shall read at least 45 volts rms with 120 volts line voltage. If the required output is achieved, proceed to 3.3.3.5.

NOTE: The following readings are approximate. Keep in mind that a lower than average reading from a particular stage may be compensated for if the following stages have higher than average gain. Tune transmitter for maximum output, then rotate PA tune fully CCW before taking readings. Don*t leave transmitter keyed in this condition for more than 30 seconds.

3.3.3.4.1 With the transmitter keyed, check for .26 volts AC $\pm$ 40% at TP 10. If this reading is obtained, adjust mic gain control so that TP-10 is .2 volts and go to 3.3.3.4.2

3.3.3.4.2 Connect VTVM to TP 11 (Filter Input). Check for 1.9 volts AC $\pm$ 20%.

3.3.3.4.3 Connect VTVM to TP 12. Check for .26 volts AC $\pm$ 30%.

3.3.3.4.4 Connect VTVM to TP 13. (Driver tube grid). Check for 1.9 volts RF $\pm$ 15%

3.3.3.4.5 Connect VTVM to TP 14 (PA tube input). Check for 15.5 volts RF $\pm$ 15%

.4.6 Connect VTVM across output connector. Voltage should be at least 45 volts RF.

TURN THE MIC

3.3.3.5 Turn the mic GAIN CONTROL fully counter-clockwise and adjust the PA tune control clockwise until a peak occurs on the VTVM. Then adjust L-10 (24 mc trap) for minimum VTVM reading. This reading should be 2.0 volts or less.

3.3.3.6 Return the PA tune control to previous setting and tune transmitter to the point of flat-topping. Adjust neutralizing capacitor C 86 until maximum output and minimum plate current occur at the same setting of the PA tune control. In order to determine the correct direction in which to turn the neutralizing capacitor, the following test may be made: Dip the plate current. Then rotate the PA tune control in the direction which produces maximum VTVM reading. If this direction is clockwise, the neutralizing capacitor must also be rotated clockwise.

3.3.3.7 Turn the mic gain control fully counter-clockwise and adjust the carrier balance pot R-25 and trimmer capacitor C23 for minimum VTVM reading. The final reading should be .4 volts or less with the USB/LSB switch in either position.

3.3.3.8 Set the Bandswitch knob to 40 meters on receive noise peak. Set the tuning dial to 7.075 mc. Advance the mic gain to mid scale, and adjust the rear slug on the slug rack for maximum VTVM reading. Adjust the PA tune and PA load controls for maximum VTVM reading advancing the MIC gain control as required to keep the scope pattern at the point of flat-topping. After completing the above adjustments, with the MIC gain control advanced to the point of flat-topping, the VTVM reading shall be at least 54 volts with 120 volts line voltage.

3.3.3.9 Test 80 meter operation by adjusting the bandswitch knob on noise peak and PA TUNE and PA LOAD controls for maximum output at 3.8 mc. The bandswitch knob setting must coincide very closely with the setting that produces maximum receiver noise. If necessary, a compromise rear-slug setting must be made to provide good receiver sensitivity and transmitter drive at the same setting of the bandswitch knob on both 40 and 80 meters. After completing the adjustments, with the MIC GAIN control advanced to the point of flat-topping, the VTVM reading on 80 meters shall be at least 50 volts with 120 volts line voltage.

3.3.3.10 Test 20 meter operation by adjusting the bandswitch knob for maximum drive and the PA LOAD and PA TUNE controls for maximum output at 14.25 mc. The bandswitch knob setting must coincide very closely with the setting that produces maximum receiver noise. With the PA TUNE and PA LOAD controls adjusted for maximum output, there shall be no signs of transmitter instability. Readjust the neutralizer as required on 20 meters to obtain stable operation and a clean two-tone pattern on the scope. Transmitter output with 120 volts line voltage and the MIC GAIN control set at the point of flat-topping shall be 54 volts minimum on 20 meters.

3.3.3.11 Test to see that transmitter output is equal with the USB/LSB switch in either position. Test operation of the TUNE/OPER switch by turning the microphone test plug switch off and setting the TUNE/OPER switch to TUNE. The scope pattern should be a solid bar with output essentially equal to that obtained with a two tone test signal.

3.3.3.12 Measure voltage at linear amp receptacle on rear panel TP 15. Voltage should be approximately 12 volts DC when the transmitter is keyed. 12

3.3.3.13 Attach the 100 kc crystal calibrator to the rear panel receptacle. Place the USB/LSB in USB. Check to see that the pitch switch is OFF and the dial correct is in the center of its range. Turn the cal switch to ON. Set the band switch to 15 meters and adjust for maximum noise. Set frequency below 21.20 mc. Rotate the frequency dial toward 21.20 mc. A beat note should be heard near 21.20 and should zero on the frequency dial mark for that frequency. Adjust C-54 until this result is obtained. Advance dial and listen for the next beat note at 21.30 and 21.40. Do not readjust C-54. Check 20M, 40M and 80M 100 kc points.

CRY
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3.3.4.0 Connect unit to 14.6 volt DC source with proper power cord. See that receiver operation is normal. Turn the "xmtr switch" to ON. The power inverter should start and tube filiaments should come on. A buzz from the speaker is normal when the inverter is operating.

3.3.4.1 Test the transmitter operation. The output should be essentially the same as with AC operation. 14.6 volts line input should be measured <u>at the set</u> when making transmitter power measurements in DC operation.

3.4 ALIGNMENT TROUBLE SHOOTING CHART

Unable to obtain requirement at step #		Check
3.3.1.2	Indicates Faulty keyer	Q 16
3.3.1.3	Indicates Faulty keyer	Q 17
3.3.1.4	Indicates improper bias voltage	Bias supply, shorted tubes
3.3.1.5	Indicates faulty B + supply	
3.3.2.1	Insufficient output from 456 kc osc.	Q12, Y1
3.3.2.2	No reading indicates faulty doubler	CR-8,T-4 Q-13
3.3.2.3	Unable to obtain correct readings	T-5, Q-13
3.3.2.4	IF reading exceeds 1. volt, change	Q-15
3.3.2.6	Unable to obtain flat beat note	CR-10,Q-18
3.3.2.7	Unable to obtain flat beat between TX & RX	CR-12,CR-13
3.3.2.8	Pitch control limited range or inoperative	CR-11,S-3 R-59
3.3.2.9	Dial correct limited range or inoperative	CR-11,R-60
3.3.2.10	Crystal osc inoperative or low output	Poor ground on PC Board Q19,Y5,L6
3.3.2.11	20 meter injection low or inoperative	Y4
3.3.2.12	40 meter injection low or inoperative	Y3
3.3.2.13	80 meter injection low or inoperative	Y2
3.3.2.14	Sensitivity low	
3.3.2.14.1	Insufficient gain in 456 amp or audio ckts. Note: to check agc circuit, remove Q-3 and note output meter. If the reading increases, fault is in the agc circuit	Q6,Q2,Q1, Q20,C16, C10,Q3,C2, C8
3.3.2.14.2	Insufficient conversion gain	Q8,T6,T3, CR 9
3.3.2.14.3	Insufficient conversion gain	Q10,Q11, L2, T6
3.3.2.14.4	Insufficient RF amplification	Q11,C 3 CR 14,15
3.3.2.15-2.17	IF readings cannot be obtained, recheck alignment	
3.3.3.2	PA Idle current low	V-2 V-3
3.3.3.3	Unit won't neutralize-Check to see that driver tube shield is making good ground	C 86, V2,V3
3.3.3.4.1	Check for adequate two-tone input Should be .015 volts.	Q4, Mod#6, C10,C6,C18
3.3.3.4.2	456 amp weak	Q5, T2
3.3.3.4.3	Insufficient conversion gain	Q7, T3,T6
3.3.3.4.4	Insufficient conversion gain from HF mixer or shorted Q11, Q10	Q9,Q10,Q11, V1,L2,L3, C90 A&B
3.3.3.4.5	Insufficient Drive from V1	V1, C90C L7
3.3.3.4.6	Low output Note: B+ should not go below 350 volts DC measured at the high voltage test point under full load	V2,V3, output Circuits, Low B+

3.4 ALIGNMENT TROUBLE SHOOTING CHART
(Continued)

Unable to obtain requirement at step #		Check
3.3.3.5	If a sharp dip cannot be obtained, replace L-10 or C-65. If dip is not low enough, try to neutralize first.	
3.3.3.6	Insufficient control from C86. Check first to see that driver tube shield is making a good ground.	C86,C90C Tuning, V2, V3
3.3.3.7	Excessive residual carrier. Any Stage producing noise sufficient to modulate the final amp will cause this reading to be higher than specified. Be sure that no audio is leaking into the unit while this measurement is being made. If no dip can be obtained with the carrier balance pot, change all the diodes in the balanced modulator	
3.3.3.11	No indication in tune	Faulty tune switch,C13 open
3.3.3.12	Continuous output	Q23 shorted
3.3.3.13	Dial non linear on one band.	Bend rear rotor plate on C48 accordingly.
	20, 40 or 80 doesn't fall within limits	Adjust appropriate crystal trimmer or replace crystal.
3.3.4.0	Inverter won't start	Q21, Q22, C67 C68, T7

3.5 TRANSISTOR VOLTAGES

Symbol	Type No.	Base	Emitter	Collector	Measured in
Q1	2N2431	10.7	11.1	0	Receive*
Q2	2N3638	10.3	11.0	7.9	Receive*
Q3	2N3642	0	0	11.1	Receive*
Q4	2N3638	10.7	11.5	8.1	Transmit
Q5	2N2672	12.1	12.4	0	Transmit
Q6	2N2672	10.3	10.6	0	Receive
Q7	2N2672	11.6	11.9	0	Transmit
Q8	2N2672	11.0	11.3	0	Receive
Q9	2N2672	12.5	12.8	0	Transmit
Q10	2N2495	12.0	12.2	0	Receive
Q11	2N2672	11.7	12.0	0	Receive
Q12	2N2672	10.5	10.1	.1	Receive
Q13	2N2672	12.8	12.6	0	Receive
Q14	2N2672	5.2	5.5	0	Receive
Q15	2N706	1.43	0.8	5.8	Receive
Q16	2N3642	-1.02	0	12.1	Receive
Q17	2N3642	.94	0	.12	Receive
Q18	2N2926	.58	0	7.1	Receive
Q19	2N2672	11.6	10.5	0	Receive **
Q20	2N2869/2N301	10.4	10.7	.63	Receive
Q21	2N443	14.5	12.8	10.0 AC	Receive
Q22	2N443	14.5	12.8	10.0 AC	Receive
Q23	2N2926	13.6	13.1	13.6	Transmit

Measurements taken with 20,000 ohms-per-volt meter, no signal input, set powered from 120 volt AC.
* Volume control full clockwise.
** On 20 m band

TRANSISTOR VOLTAGES

Symbol	Type No.	Base	Emitter	Collector	Measured in
Q1	2N2431	10.7	11.1	0	Receive *
Q2	2N3638	10.3	11.0	7.9	Receive *
Q3	2N3642	0	0	11.1	Receive *
Q4	2N3638	10.7	11.5	8.1	Transmit
Q5	2N2672	12.1	12.4	0	Transmit
Q6	2N2672	10.3	10.6	0	Receive
Q7	2N2672	11.6	11.9	0	Transmit
Q8	2N2672	11.0	11.3	0	Receive
Q9	2N2672	12.5	12.8	0	Transmit
Q10	2N2495	12.0	12.2	0	Receive
Q11	2N2672	11.7	12.0	0	Receive
Q12	2N2672	10.5	10.1	0.1	Receive
Q13	2N2672	12.8	12.6	0	Receive
Q14	2N2672	5.2	5.5	0	Receive
Q15	2N3564	1.43	0.81	5.8	Receive
Q16	2N3642	-1.02	0	12.1	Receive
Q17	2N3642	.94	0	.12	Receive
Q18	2N2926	.58	0	7.1	Receive
Q19	2N2672	11.6	10.5	0	Receive **
Q20	2N2869/2N301	10.4	10.7	.63	Receive
Q21	2N443	14.5	12.8	10.0 AC	Receive
Q22	2N443	14.5	12.8	10.0 AC	Receive
Q23	2N2926	13.6	13.1	13.6	Transmit

Measurements taken with 20,000 ohms-per-volt meter, no signal input, set powered from 117-volt AC.

* Volume control full clockwise.

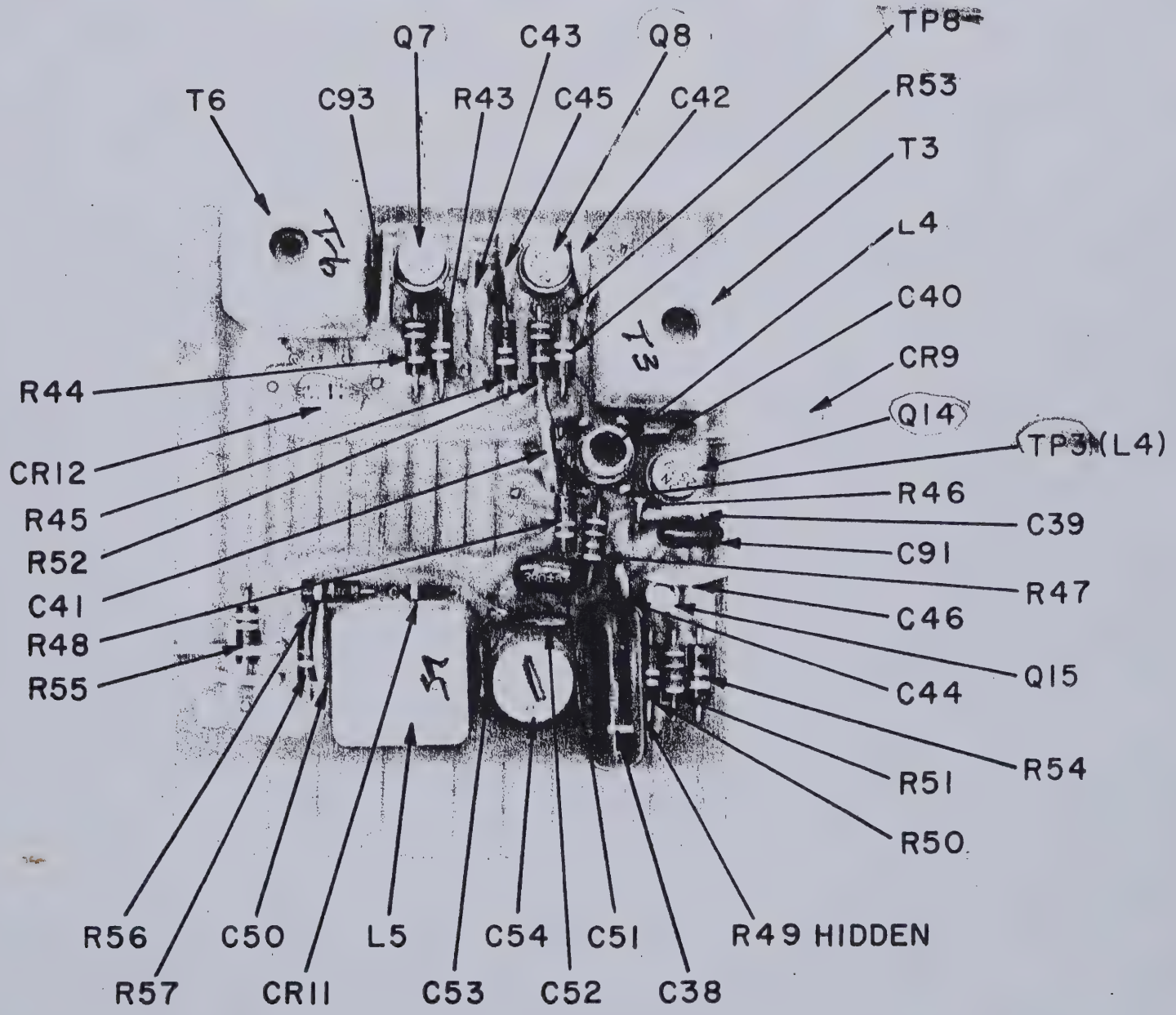
** On 20 m band

TUBE VOLTAGES

	PIN NUMBER							
Tube	1	2	3	6	7	8	9	Cap
V1	6	0	6		405	170	0	
V2, V3	-22	-22	0	150	150	0	-	405

Notes:

1. 6 V.D.C. between filament pins 4 & 5 of V2 & V3. V1 filament pins 4, 5 and 6.
2. All measurements made with 120 V.A.C. input, microphone button depressed.


Q7
C43
Q8
TP8
T6
C93
R43
C45
C42
R53
T3
L4
C40
CR9
Q14
TP3 (L4)
R46
C39
C91
R47
C46
Q15
C44
R54
R51
R50
R49 HIDDEN
C38
C52
C53
C54
L5
C50
C51
CR11
R57
R56
R55
R48
C41
R52
R45
CR12
R44
T2
T1

VFO BOARD

SBE WARRANTY

The Sideband Engineers equipment described herein is sold under the following guarantee:

SBE agrees to repair or replace, without charge, any equipment, parts, or accessories which are defective as to workmanship or materials and which are returned to SBE at its factory or an authorized warranty station, transportation prepaid, provided:

1. Notice of the claimed defect is given SBE or an authorized warranty station, or an authorized Distributor, in writing, within 90 days from the date of purchase and goods are returned in accordance with SBE instructions.

2. The warranty registration card has been filed within 10 days from date of purchase.

3. Equipment, accessories, tubes, semi-conductors and batteries not manufactured by SBE or from SBE designs are subject to only such adjustments as SBE may obtain from the supplier.

4. Failures due to use of equipment for purposes other than normal amateur operation or in violation of the SBE instruction manual shall not be deemed a defect.

This Warranty is not valid if the equipment is altered, modified or repaired by persons other than SBE or an authorized warranty station. Alteration or modification in accordance with SBE Service Bulletins shall not affect this Warranty.

SBE reserves the right to make any change in design or to make additions to, or improvements in SBE products without imposing any obligation upon SBE to install them in previously manufactured SBE products.

No other warranties, express or implied, shall be applicable to this equipment, and the foregoing paragraphs shall constitute the Buyer's sole remedy under the agreements contained in this Warranty. In no event shall SBE have any liability for damages, loss, or expense directly or indirectly arising from the use of the product, or any inability to use them either separately or in combination with other equipment or from any other cause.

For Warranty Service see inside back cover.

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Transistor Voltage Chart
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Printed in U.S.A.

I. GENERAL DESCRIPTION

The Sideband Engineers Model SB-34 is a single-sideband, suppressed-carrier transceiver intended for operation in the A3 portions of the U.S. 80, 40, 20 and 15-meter amateur bands. The SB-34 operates either upper or lower sideband; selection is made by a front-panel switch. There is no carrier shift when emission is changed from one sideband to the other. Peak effective power output exceeds 60 watts on the 80, 40 and 20-meter bands, and 50 watts on the 15-meter band.

The SB-34 is self-contained, requiring only a microphone and an antenna for operation. The SB-34 will operate from either a 117-volt AC, or 12-volt DC (negative ground) power source; the two-way power supply is an integral part of the unit. Selection between the two power sources is automatically made when the proper line cord is connected.

Provisions are made for the use of a VOX unit and a 100-kc crystal calibrator which are available as accessory items. A front-panel switch is provided to control the calibrator unit. An accessory plug is also provided on the rear panel for control of the Sideband Engineers external Linear Amplifier companion unit.

All stages of the SB-34 except the transmitter driver and power amplifier are transistorized. The use of bilateral amplifiers and mixers, which amplify in one direction on transmit and in the other direction on receive, permits the use of a single bandpass circuit train. Duplication of circuitry is eliminated through use of common circuit elements for both receive and transmit functions.

The unique bandswitching and exciter tuning control permits adjustment of both functions with a single front-panel knob. Other controls and adjustments are held to a minimum for simplified operation. Exceptional receiver performance is obtained through the use of post-alloy diffused transistors and a 2.1-kc Collins mechanical filter. A pitch control is provided for tuning the receiver approximately 500 cycles either side of the transmitted frequency. The control may be disabled and the receiver locked to the transmitted frequency. A stand-by switch is also provided to turn off the transmitter-tube heaters and the high-voltage power supply during mobile operation. With this switch off, power drain from the car battery is reduced to 0.6 amps.

The entire transceiver package is less than one-half cubic foot in volume and weighs approximately 18 pounds. Construction of heavy-gauge steel and aluminum, and extensive use of printed circuit boards, provide an extremely rugged package, virtually immune to the effects of vibration and shock.

II. SPECIFICATIONS

Type of emission:	Single sideband, suppressed carrier, upper or lower sideband selectable from front panel
Frequency range:	3.775 - 4.025 mc, 7.05 - 7.3 mc, 14.1 - 14.35 mc, 21.25 - 21.45 mc
Power consumption:	117 VAC - receive 35 watts - transmit (single tone) 165 watts 12 VDC - standby 0.6 amps - receive 3.6 amps - transmit (single tone) 14 amps
Power output (PEP):	80, 40, 20 meters: 60 watts minimum 15 meters: 50 watts minimum
Carrier suppression:	50 db
Unwanted sideband suppression:	40 db at 300 cycles
Distortion products:	Down at least 25 db
Spurious responses:	Down at least 40 db
Antenna output impedance:	40 - 100 ohms, unbalanced. VSWR not to exceed 2:1
Sensitivity:	Less than 1 microvolt for 10 db signal-to-noise ratio
Selectivity:	2.1 kc at 6 db down, 4.5 kc at 60 db, both transmit and receive
Audio output:	2.0 watts at 10% distortion, 3 watts maximum
Dimensions:	5" high, 11-1/8" wide, 9-1/2" deep
Weight:	Approximately 18 pounds

III. INSTALLATION

1. GENERAL

The SB-34 transceiver is designed to provide a complete single-unit installation for fixed, portable, or mobile operation. No special precautions need be observed in the choice of location provided adequate ventilation space is available. A minimum of two inches of air space above the cabinet top and on all sides is recommended to allow proper air flow around the top and bottom of the cabinet. Do not place the unit on a car seat or similar surface which may block ventilation through the bottom. Never stack other units above or below the cabinet since the accumulated heat could cause permanent damage.

2. FIXED STATION

Plugging the 117-volt AC power cord into the receptacle at the rear of the transceiver connects all power circuits for 117 volt AC operation. The set

should be connected to a good water-pipe ground. The ground may be connected either to the external speaker terminal labelled GND or to the braid of the antenna cable.

3. ANTENNA

Results both in receiving and transmitting will depend largely on the antenna; the receiver is particularly sensitive to the type of antenna used. Any of the common antenna systems designed for use on the high-frequency amateur bands may be used with SB-34 provided the input impedance of the antenna system is within the capability of the pi-output matching network (40 - 100 ohms resistive). If tuned open-wire transmission line is used, or if a long wire antenna is desired, a suitable antenna tuner must be used between the transceiver and the antenna to provide an impedance match between the unbalanced coaxial output and the balanced open-wire line or long wire.

4. LINEAR AMPLIFIER

The SB-2 LA linear amplifier has been designed for use with the SB-34 and matches the SB-34 in physical appearance. The required switching and control circuits are incorporated. In addition, the SB-34 transceiver may be operated in conjunction with other conventional linear amplifiers. A plug on the rear panel provides a 12-volt DC potential for actuating the control relays of the amplifier selected when the transceiver switches to transmit. If the linear amplifier relays are not intended to operate from such a voltage, an intermediary relay must be used. Any 12-volt relay may be used provided the coil resistance is 100 ohms or more.

5. MOBILE OPERATION

The SB-34 will operate satisfactorily from any 12-volt negative-ground battery source by connecting the DC power cord to the rear-panel receptacle. Due to the unusually small size of the SB-34, under-dash mounting is possible in many cars with limited available space. The Model SB-2 MB Mounting Bracket is available as an accessory.

When making connections to the car battery, be certain that the RED lead is connected to the positive (+) terminal and the BLACK lead to the chassis ground (-); reversed connections could permanently damage the transceiver. It is strongly recommended that the red lead be connected directly to the battery and not to the ammeter or an accessory terminal.

Note: Prior to operating the SB-34 in a mobile installation, the automobile voltage regulator setting should be checked. Many times, even in new cars,

the regulator is adjusted for an excessively high charging voltage. In addition to being injurious to the car battery, this high voltage could cause permanent damage to the SB-34. Make certain before operating that the voltage, when charging, does not exceed 14.6 volts.

Most of the commonly used mobile antennas will give excellent results with the SB-34. Make certain that the outer braid of the coaxial cable is securely grounded to the chassis at the antenna mount.

Noise generated by the ignition system, generator, etc., will usually interfere with weak-signal reception, especially on the higher-frequency bands. Since procedure for eliminating this noise varies with different makes and models of cars, no specific instructions for noise reduction can be given here. Valuable noise reduction information is given in the Amateur Mobile Manuals and these publications should be consulted or one of the several ignition noise suppression kits available should be considered.

If a mobile installation of higher power is desired, the Sideband Engineers companion Linear Amplifier is recommended for use with the SB-34. A special solid-state inverter is available for use with the amplifier to provide a practical 1000-watt mobile installation. Contact your dealer or Sideband Engineers for further particulars.

IV. OPERATION

NOTE: The SB-34 transceiver has been specifically designed to provide the utmost ease of operation and adjustment. All panel controls have been thoroughly tested before shipment from the factory. Several of the controls are unusual in operation, however, and improper adjustment may result in signals of poor quality, and even out-of-band operation. Read this section carefully before attempting to operate the transceiver.

1. CONTROL FUNCTIONS

The various front-panel controls and their functions are described in detail in the following paragraphs. Make certain that you understand the function of each control before attempting to operate the transceiver. Detailed instructions are given for tuning the transmitter. The design of the unit is such that when the transmitter is properly tuned, the receiving portion of the set is also properly aligned to the frequency in use.

1.1 Volume Control. The power ON/OFF switch and volume control functions are combined on a single control knob located at the lower left corner of the

front panel. Operating the knob clockwise beyond the click turns the unit on. Since the receiver portion of the unit is completely transistorized, no warm-up period is required.

A unique AGC system is incorporated in the SB-34. As the volume control is advanced, strong AGC action occurs as the set reaches normal room volume. From this point on, the volume remains substantially constant until the control is about three-quarters advanced. Beyond this point, the volume rises rapidly until full audio output is obtained with the control fully clockwise. For home use, the volume control is normally operated in the first half of its range. With mobile operation, where more audio output is usually required, the control is advanced into the second half of its range. Keeping the volume control at a low, but comfortable, level will reduce the "pumping" action that may occur on SSB signals.

1.2 Tuning Knob. The large knob directly below the dial window controls the actual frequency of operation after the desired band has been selected. A dual-speed reduction drive is incorporated to provide a slow tuning rate and, at the same time, to cover the entire band rapidly. In operation, the knob is turned to the desired portion of the frequency band and slightly past the desired frequency. When the knob rotation is reversed, the vernier action is increased by six for one complete revolution. Further rotation again engages the quick drive action. Since the tuning rate, in slow drive, is 14 kc per revolution, there is no critical "feel" to the dial. An additional feature of this mechanism is that the dial is positively locked to prevent mechanical frequency drift under vibration.

1.3 Microphone Connector. The microphone jack is located at the lower center of the panel. The jack accepts a type PL-68 (small diameter) plug with the microphone connected to the sleeve and the push-to-talk switch connected to the tip. The SB-34 transceiver is designed to operate with a medium or high-impedance dynamic microphone such as the SBE Model SB2-MIC. Crystal or ceramic microphones will give poor results unless an auxiliary pre-amplifier is used, because of the very high impedance of the microphone and the low-impedance transistor microphone amplifier. In addition, the rising characteristic of this type of microphone combined with the narrow bandpass of the mechanical filter employed in the SB-34 produces a somewhat unpleasant sound to the average voice. Carbon microphones will operate only if external provisions are made for supplying them with operating current.

1.4 Bandswitch. The bandswitching and exciter tuning functions are combined in a single knob located just below the meter. With the knob indication fully clockwise, the transceiver is set for 80 meters, and the front end of the receiver is peaked by rotating the knob through the arc labelled "80". Correct tuning is indicated by a sharp rise in background noise similar to that obtained

with the "antenna tuning" control on a conventional receiver. To change to 40 meters, the knob is rotated counter-clockwise beyond the 80-meter arc. A click will be heard between the 80 and 40-meter arcs. This is the bandswitch operating to the 40-meter position. Tuning is again performed by rotating the knob within the 40-meter arc for a sharp rise in noise. This is progressively repeated for operation on the 20 and 15-meter bands. A stop is provided at the extreme counter-clockwise end of rotation past the 15-meter arc. WARNING! Do not attempt to move the knob past this stop! Damage may result. The knob may slip and cause loss of calibration. If this should happen, turn the bandswitch knob fully clockwise, loosen the set screws and set the knob index exactly on the clockwise stop mark on the panel. Tighten the set screws securely. Further adjustment of the bandswitch knob is covered in the TRANSMITTER TUNEUP section.

1.5 Pitch Control. The pitch control, located to the right of the volume control, provides a means for tuning the receiver frequency slightly to either side of the transmitting frequency. Thus, it is possible to set the pitch of the voice you are receiving to the most readable point without affecting your transmitting frequency. Its use is particularly valuable in "net" contacts where several of the participants may be transmitting slightly off frequency. The pitch control may be switched off and the receiver locked to the transmitting frequency by operating the PITCH switch (between the volume control and the pitch control) to the OFF position. Normally, you will want to keep the pitch control turned off until the initial contact is made. After accurately zeroed with the other station, the pitch control may be used to correct for any drift at the other end of the contact. This technique prevents the "leap-frogging" so prevalent with transceivers.

1.6 Dial Correct. The dial correct knob, located to the right of the dial window, is used to adjust for any error in dial calibration. The transceiver is aligned at the factory for correct dial readings with the correct knob index straight up. If an accurate calibration signal is not available, the correct knob should be left in this position. An accessory 100-kc calibrator unit is available for accurately setting the dial. Alternately, the dial can be corrected on a signal of known accuracy. The use of other amateur signals for this purpose is, in general, not advisable. The calibration of many amateur transmitters is subject to question.

1.7 USB/LSB Switch. This switch sets the transceiver to receive and transmit on either the upper sideband or the lower sideband. In general, it is common practice to use lower sideband on 80 and 40-meter band frequencies, and upper sideband on 20 and 15-meter frequencies. However, occasionally you will find exceptions. If the signal cannot be made intelligible by any amount of tuning, it is probably transmitting the sideband opposite to that which is selected on the USB/LSB switch. Changing the position of this switch does not disturb the dial calibration and no retuning is required.

1.8 CAL Switch. This switch controls the 100-kc calibrator unit which is an accessory item. Moving the switch up to the ON position inserts a beat signal every 100 kc on all bands.

1.9 XMTR Switch. With this switch in the down position, the transmitter tube heaters and the high-voltage supply are turned off when the transceiver is operating mobile. This reduces battery drain to 0.6 amps and thus permits long periods of listening without fear of excessive battery drain. Operating the switch to the ON position actuates the high-voltage supply and the tube heaters. An audible hum from the built-in DC power supply transformer will be evident with the switch in the ON position; however, the hum level is low and will not interfere with the reception of a signal in the normal mobile environment. After a 30-second warm-up period, the transmitter is ready for operation. The XMTR switch operates only when the set is powered from a 12-volt DC battery; it does not function with 117-volt AC operation. With 117 volts AC, the heaters and high voltage supply are energized at all times

1.10 PA TUNE. The PA TUNE control is intended primarily for loading the transmitter to the antenna. However, for maximum receiver sensitivity, it must be set to the point which is correct for transmitting. If the transmitter section is not being operated, adjust the PA TUNE control for maximum receiver volume with the PA LOAD capacitor set at one turn back from maximum clockwise position. Otherwise, see TRANSMITTER TUNEUP section.

1.11 Transmitter Controls. The controls used exclusively in transmitting are: MIC GAIN, PA LOAD, METER Switch, and TUNE-OPER Switch. Their use is described in the TRANSMITTER TUNEUP section.

2. RECEIVER OPERATION

The SB-34 transceiver employs a 2.1 kc Collins mechanical filter to attain exceptional selectivity on both receive and transmit. The unit is designed to pass only that portion of the voice spectrum falling between 300 and 2400 cycles. Experience has shown that this bandwidth permits excellent intelligibility and still discriminates against interfering noise. Since the transceiver audio system and speaker is also carefully shaped to pass only 300 to 2400 cycles, the end result is reception similar to the quality of a conventional telephone. No adjustment of the transceiver will produce "high fidelity" reception in the normal sense. The SB-34 will, however, provide good communications under conditions of high noise and weak signals when conventional receivers with extended audio range and wide bandpass are completely unusable.

Considerable effort has been expended to prevent the receiver from overloading or blocking on strong signals. Since the volume control mainly affects the

RF section of the receiver rather than the audio circuits as is customary, the receiver is less likely to overload at low volume settings than at a high setting. Quite often interference from close-by stations can be completely eliminated by merely reducing the volume control setting. An automatic gain control system (AGC) is incorporated in the transceiver. It provides strong compression on signals when the audio output exceeds one-quarter watt (normal room volume). If more audio is required, as when operating mobile, turning the volume control into the upper half of its range increases the audio output to a maximum of three watts.

A few spurious responses (birdies) may be noted as the receiver is tuned through the various bands. With a normal antenna and in an average location, all of these responses will be below the level of a readable signal, with the exception of a single response at 7300.8 kc. Since this response is outside the amateur band, it should cause no inconvenience to the operator. It is, in fact, useful as a means of checking the dial accuracy, since it has the stability of the carrier oscillator and may be relied upon to be accurate as a frequency marker.

3. TRANSMITTER TUNEUP

NOTE

> Improper transmitter tuning can result in serious distortion and possibly operation outside the band. Improper adjustment of the MIC GAIN control can cause "flat-topping" and the generation of splatter and other spurious emissions. Make certain you understand the following instructions thoroughly before attempting to operate the transmitter.

Transmitter tuneup consists of adjusting the exciter, loading the power amplifier to the antenna, and setting the microphone gain control for optimum power output without distortion. The SB-34 has been carefully designed to minimize the possibility of improper operation due to faulty tuning procedures, and to make the tuneup process as simple and quick as possible.

The combination bandswitch and driver tuning, for instance, has been arranged to preclude the possibility of tuning up on incorrect frequencies. It is, however, possible to transmit a poor signal if the set is not correctly tuned. Take the time to memorize the following step-by-step procedure and your SB-34 will always transmit a clean, powerful signal that will be a credit to your station.

3.1 Power Amplifier and Driver Tuning. With the transceiver turned on, allow 30 seconds for warm-up of the transmitter tubes. Make certain an antenna

resonant to the band in use is connected. Set the controls as follows:

1. TUNE-OPER - to OPER.
2. DIAL CORRECT - center of range.
3. PITCH - off.
4. METER - Ip (in this function meter indicates PA plate current x 100 ma (0-500 ma).
5. Band Selector - to desired band.
6. Tuning Knob - to desired frequency.
7. PA TUNE - full counter-clockwise (max. capacity).
8. PA LOAD - full counter-clockwise (max. capacity).
9. MIC GAIN - full counter-clockwise (min. gain).

3.1.1 Adjust the bandselector knob within the arc of the band selected for maximum receiver noise.

3.1.2 Set the TUNE-OPER switch to the TUNE position. The receiver will "quiet" and the meter will indicate PA plate current.

3.1.3 Carefully re-adjust the band selector knob for maximum meter indication. This will occur at a setting very close to that which produced maximum receiver noise. One or more peaks may be evident if the band selector knob is tuned through the entire arc, but the correct setting will always be near the point of maximum receiver noise, and will always produce a much higher meter reading.

3.1.4 Turn the PA TUNE control clockwise until a sharp dip in meter indication occurs.

3.1.5 Set meter switch to ANT. In this function, the meter measures voltage across the antenna circuit and the amplitude of the readings will be dependent on the actual antenna circuit impedance. The meter, therefore, should be used only as an indicator of optimum transmitter tuning into the particular antenna.

3.1.6 Turn the PA LOAD control clockwise for maximum (peak) meter reading. NOTE: The PA LOAD control is a mica compression trimmer. This control rotates at least four full turns to go from minimum to maximum capacity.

3.1.7 Re-adjust PA TUNE control for maximum (peak) meter reading.

3.1.8 Repeat steps 3.1.6 and 3.1.7 until the meter reads maximum possible, with final adjustment being the PA TUNE control.

(If it is not possible to tune through a peak meter reading when adjusting the PA TUNE or PA LOAD control, the antenna system presents an input impedance

which is beyond the matching capabilities of the pi-network (40-100 ohms resistive) and the antenna system should be checked).

3.1.9 Switch meter back to Ip, note meter reading and return TUNE-OPER switch to OPER. Normal plate current should be 200 to 250 ma.

3.2 MIC GAIN Adjustment. Turn the METER switch to Ip position and the TUNE-OPER switch to TUNE long enough to note the meter reading.

With the transceiver properly tuned to a resonant antenna, the reading should be between 2.0 and 2.5. (In mobile operation with the engine off during tune-up, this reading may be slightly lower.) Return the TUNE-OPER switch to OPER, press the microphone button and speak a steady "Ahhh" into the microphone at the level and distance you intend to use when transmitting. Gradually turn the MIC GAIN control clockwise until the meter reading increases to approximately 1.5 if the maximum reading was 2.5; or 1.3 if the maximum reading was 2.0. This setting of the MIC GAIN control will ensure a strong transmitted signal without danger of overdriving.

NOTE

It is very important that the MIC GAIN control be correctly set. If it is too high, excessive distortion will be produced. On the other hand, too low a setting will result in low transmitter output. On-the-air reports should be taken with caution since they are subject to many inaccuracies.

V. THEORY OF OPERATION

The SB-34 single sideband transceiver is essentially bilateral. With the exception of the receiver RF amplifier and the high-level transmitting stages, the signal stages may amplify in either direction. During the receive function they amplify in one direction, on transmit they amplify in the opposite direction. The same tuned circuits are used for both transmitting and receiving. The various injection oscillators operate continuously, supplying the local oscillator signals to the proper mixer stages.

All transistors in the transceiver operate in the common emitter configuration except the receiver RF amplifier Q11. This stage operates common base.

A typical bilateral stage may be understood by referring to the 456 kc amplifier Q5-Q6 in the schematic diagram. With the microphone button released, the base bias resistor of Q5 is returned to a line which carries a +12-volt

(Receive mode)

potential. The transistor cannot conduct. The base bias resistor of Q6, however, is returned (through the volume control) to a line which is essentially ground potential with the microphone button released and Q6 is in conduction and able to amplify. Thus, with the microphone button up, a signal appearing at the mechanical filter will be amplified and delivered to IF transformer T2. With the microphone button pressed, the two bias-control lines are inverted in polarity so that Q6 is cut off and Q5 is able to conduct. Therefore, a signal appearing at T2 is amplified by Q5 and impressed on the filter. Similarly, the amplifying direction of the VFO mixer Q7-Q8, and the high-frequency mixer Q9-Q10 are controlled by the two bias control lines.

Xmit mode

Unilateral stages that are required to operate only on receive or transmit are turned off when not needed by returning their base bias resistors to the appropriate bias control line. The transmitter tubes are disabled during receive by applying a high negative bias to their grids.

1. TRANSMIT FUNCTION

An audio signal from the microphone, controlled in amplitude by the MIC GAIN control, is amplified by the microphone amplifier Q4 and applied to the ring-balanced modulator CR3-7. Crystal oscillator Q12 operating at 456.38 kc, provides a carrier to the modulator. Carrier balance is obtained by a potentiometer and a trimmer capacitor. Double-sideband, suppressed-carrier output from the balanced modulator is amplified through T2 by the bilateral amplifier Q5-Q6. The amplified signal is then passed through the mechanical filter which suppresses the upper sideband.

and T-4.

Output from oscillator Q12 is also applied to frequency doubler CR8. The doubled carrier frequency from this stage is then either doubled again or tripled by Q13. With the mode selector switch set at USB, the frequency is tripled; with the switch on LSB the frequency is doubled. Thus, on USB, a 2738.2 kc (456.38 x 6) signal appears at the output of T5. On LSB an 1825.5 kc (456.38 x 4) output appears at T5.

Doubler/tripler transformer T5 is connected in a ring with the mechanical filter, mixer CR9, and transformer T3 which is tuned to 2281.9 kc. With the mode selector in LSB, output from T5 is additively mixed with the lower-sideband signal from the filter to produce a lower sideband signal at 2281.9 kc. With the mode selector set on USB, the T5 output is subtractively mixed with the filter output to generate an upper-sideband signal, still at 2281.9 kc. Thus, the mode selector, by adjusting Q13 to either double or triple, determines the mode of the sideband signal. Since all of the frequencies involved are derived by a single oscillator, no shifting of carrier frequency can occur and no retuning is necessary when switching sidebands.

With the TUNE-OPER switch in TUNE position, a measured amount of carrier signal is inserted in the DC load resistor of mixer CR9 for transmitter tune-up purposes only. NOTE: Power output measured in the TUNE position with a power meter is not indicative of the PEP output of the transmitter.

The 2281.9 kc upper or lower sideband output from T3 is applied to VFO mixer Q7-Q8. Also applied to this mixer is an injection signal which is tunable from 5456.9 kc to 5706.9 kc. This injection is generated by VFO Q15 and isolated from the load by VFO buffer Q14. Tunable IF transformer T6, connected to the output of VFO mixer Q7-Q8, tunes the frequency range 3175 through 3425 kc. This frequency range is the result of subtractively mixing the incoming 2281.9 kc sideband signal with the VFO injection. Transformer T6 is gang-tuned with the VFO and thus is always accurately tuned to the desired frequency.

The 3175 kc to 3425 kc sideband signal from Q7-Q8 is applied to high-frequency mixer Q9-Q10. Also applied to this mixer is an injection from high frequency crystal oscillator Q19. The frequency generated by this oscillator may be 7200, 10475, 17525, or 24625 kc depending upon the position of the bandswitch. Here again, the 3175-3425 kc incoming signal is subtractively mixed to produce the final output frequency. Output from mixer Q9-Q10 appears across tuner coil L2. The resonant frequency of L2 is controlled by a large variable capacitor and a special slug which penetrates into the coil an amount depending upon the setting of the bandswitch. The large variable capacitor is mechanically linked to the bandswitch through a Geneva movement so that rotating the capacitor shaft tunes the coil through a limited range bracketing the selected operating band. Changing the bandswitch to the next band tunes a limited range bracketing this band, etc. On 80 meters, the slug is almost fully penetrated into the coil and the capacitor is near maximum capacity. On 40 and 20 meters, the slug and capacitor are at near mid-range, and on 15 meters the slug is fully withdrawn and the capacitor is near minimum. By this unique method of tuning and bandswitching, the Q and inductance/capacitance ratio of L2 and the variable capacitor are near optimum on all bands, and the resonant impedance remains essentially constant across the entire tuning range. This tuning is ganged with, and duplicated in, antenna coil L3 and driver coil L7 which results in exciter train tuning with only one control.

The single-sideband suppressed-carrier final output signal from L2 is applied to the grid of transmitter driver V1 where it is amplified, and appears across L7. A low-impedance winding on L7 couples the signal to the paralleled grids of power amplifier V2 and V3. Neutralization of the power amplifier is accomplished by feeding back a small amount of the output through Cn to the top of L7 with the low-impedance winding providing the necessary phase reversal.

Final output from V2 and V3 is fed to a pi-section network consisting of L9 and the PA TUNE and PA LOAD capacitors. A section of the bandswitch adjusts the

inductance of L9 to the correct value for each band, and also adds fixed amounts of capacity to both the PA LOAD and PA TUNE capacitors on 80 meters.

2. RECEIVE FUNCTION

With the microphone button released, a signal from the antenna is loosely coupled from the transmitter pi-section net to the top of L3. Diodes CR14 and CR15, across L3 conduct only when extremely strong signals are present and do not otherwise affect the circuit. The signal at L3 is coupled to the emitter of Q11 which operates as a common-base amplifier. The amplified signal from Q11 is applied to high-frequency mixer Q9-Q10 through L2. With injection from Q19, this stage converts the signal to a frequency within the range 3175-3425 kc. The converted signal is then mixed by Q7 and Q8 to 2281.9 kc with injection from the VFO Q14 and Q15. The converted signal is finally mixed by diode CR9 to the 456.38 reference frequency in a manner exactly opposite to that described for this stage during the transmit function. Output from the filter is then amplified by Q5 and Q6 and coupled through T2 to the ring modulator CR3-CR7.

With BFO injection from the carrier oscillator, the ring modulator now functions as a detector, and produces an audio output which is applied to the base of Q2. Output is taken from the collector and coupled to audio driver Q1. This stage, in turn, drives the audio power amplifier Q20 which increases the signal to speaker level.

The VOLUME control sets the gain of the high-frequency mixer, the 456 kc amplifier and, to a small extent, the first audio amplifier, Q2. Other signal stages operate at full gain except in the presence of AGC action.

RF amplifier Q11 and IF amplifier Q5-Q6 are gain controlled by AGC amplifier Q3. An audio signal appearing across the speaker terminal causes Q3 to conduct heavily. The voltage at its collector is normally close to that of the supply, +12 volts. When Q3 conducts, however, the collector potential falls rapidly and charges the 250-mfd capacitor (connected between collector and the 12-volt bus) to some value less than 12 volts. This AGC voltage is connected to the emitters of the RF amplifier and the 456 kc amplifier, and as the AGC voltage falls toward ground potential, the gains of these stages are reduced until the audio output is stabilized. The AGC action is proportioned such that the RF amplifier becomes largely cut off in the presence of even moderate signals so that following stages are protected from signal overload. If the signal fades, causing the audio output to drop, Q3 conducts less and the 250-mfd capacitor slowly discharges toward the +12-volt potential, causing the stages gains to be restored as necessary to maintain the audio level.

power consumption. A high-voltage winding of T7 is connected to a voltage tripler circuit CR17, CR18 and CR19 to supply approximately +450 volts to the transmitter tubes and +150 volts to the screen grids of V2 and V3. Another small secondary winding is half-wave rectified by CR20 to supply negative bias to the transmitter tubes.

With 117-volt AC operation, T7 is energized by a second primary winding. The feedback and collector windings of the transformer are connected essentially in series and full-wave rectified by the collector-base diodes of Q21 and Q22 to provide a high-current +12 volts output. This voltage is used to operate the transistorized stages and operate the transmitter tube heaters. The high-voltage and bias systems operate as described above. The XMTR switch, in this mode of operation is not connected; the transmitter tube heaters are energized at all times.

A special regulator circuit is provided to stabilize the voltage to the VFO, Q14 and Q15. Regulator Q18 operates as a shunt regulator across the +12 volt bus to provide an output of +7.0 volts. The current to the base of Q18 is determined by the current flow through zener diode CR10, and since this zener diode in itself is not a perfect regulator, the output voltage from Q18 would normally vary slightly as the supply voltage changed. To overcome this variation, a small variable resistor is inserted in the series-dropping resistor line to the regulator transistor. The effect of this variable resistor is to insert an additional amount of base current to the transistor to offset the slight change that occurs in the zener diode due to supply-voltage changes. Thus, with proper adjustment of the resistor, regulation becomes perfect for input supply voltages of 11.5 to 15.0 volts.

5. PITCH CONTROL

The purpose of the PITCH control is to permit slight adjustment in receiver frequency with respect to the transmitting frequency. The control may be switched in or out as desired. A small silicon diode, CR11, is connected between the "hot" end of the VFO coil L5 and a voltage divider network which may be adjusted to a value between the regulated voltage (+7 volts) and ground. The diode is connected so that a reverse bias is applied and therefore appears as a small capacitor, the actual value of capacity being variable depending on the amount of reverse bias applied.

The voltage divider network supplying bias to the diode contains, in one leg, the DIAL CORRECT potentiometer. This leg is active on both transmit and receive. The other leg of the network is divided into two sections, one operating on transmit, the other on receive. On transmit, the leg consists of a 470-ohm resistor and diode CR12 which is arranged to conduct only on transmit. On receive, the leg consists of either an adjustable resistor (when the PITCH

switch is OFF) or the PITCH control (when the PITCH switch is on) and diode CR13 which conducts only on receive.

The overall effect of the PITCH control network is to permit a slight variation in VFO frequency on both transmit and receive by the DIAL CORRECT control, and a variation on receive only by the PITCH control. The adjustable resistor, activated when the PITCH switch is off, is factory set so that the VFO frequency on receive is exactly the same as on transmit.

VI. TROUBLESHOOTING

The SB-34 transceiver has been carefully aligned and tested at the factory, and all adjustments that might become misaligned from the effects of vibration and temperature cycling have been securely locked in place.

Problems that might possibly arise, and their detection and correction, are included in the following paragraphs.

1. CARRIER BALANCE

The SB-34 is designed to maintain carrier suppression of at least 50 db below full output for extended periods of time. If for any reason excessive carrier is present, the carrier balance potentiometer on the rear panel should be readjusted. The most accurate method for doing this requires a fairly sensitive vacuum-tube RF voltmeter, such as the Hewlett-Packard HP-410B, or equivalent, connected across the antenna terminals. With the MIC GAIN control set fully counter-clockwise, and the microphone button pressed, the residual carrier, as measured by the voltmeter, should be nulled to a value of 0.2 volts rms, or less, by use of the carrier balance potentiometer. Check operation on both sidebands since there may be a slight difference in carrier between the two modes. Any difference should be averaged out by the potentiometer. If it is not possible to reduce the carrier to a reading of 0.2 volts with the potentiometer alone, remove the set from the cabinet, and readjust the carrier balance trimmer (see top-view layout chart). The trimmer and the potentiometer interact somewhat so that several cycles of adjustment may be required. Note: T2 adjustment can also affect carrier balance.

2. LOW TRANSMITTER OUTPUT

Low transmitter output generally indicates weak tubes. If the off-resonance plate current of the power amplifier stage becomes less than 200 ma, as indicated on the front-panel meter, either the driver or power amplifier tubes may require replacement. If the power amplifier tubes are replaced, reneutralization may be necessary. The neutralizing capacitor (Cn) must be adjusted with an insulated alignment tool. Proper neutralization is indicated

when maximum output and minimum plate current occur with the same setting of the PA TUNE control. The adjustment should be made with the set tuned for 15-meter operation. (See Section 10.1 for Neutralizing Method.)

3. LOW RECEIVER SENSITIVITY

Since the receive portion of the transceiver is fully transistorized, no loss in sensitivity should be experienced with age. If the receiver seems to be lacking in sensitivity, the RF trimmer and slug (see layout charts) may require touch-up. Make certain that the transmitter is properly tuned to the antenna before making the adjustment. The slug may be reached through the side of the chassis and requires a long screwdriver, completely non-metallic.

Low audio output or distortion may also be traced to leaky or shorted electrolytic capacitors in the audio portion of the receiver or transmitter. These will usually cause abnormal voltage readings at the various stages. Refer to the voltage chart.

VII. ALIGNMENT

WARNING

Dangerous high voltage is present in the equipment whenever the unit is turned on. The high-voltage filter capacitors remain charged at all times and can cause fatal shock under certain conditions. Allow at least five minutes after the unit is turned off for the filter capacitors to discharge. Always remove the line plug from the outlet when servicing the set.

1. EQUIPMENT REQUIRED

For correct alignment, an accurate vacuum-tube RF voltmeter such as the Hewlett-Packard HP-410B, a calibrated audio voltmeter, and a well-calibrated RF signal generator such as the Measurements Model 65B are required. Do not attempt alignment unless accurate equipment is available.

2. ALIGNMENT PROCEDURES

NOTE: Refer to layout charts for location of various components and test points. Use test probes with caution; an accidental short will usually cause permanent damage to transistors.

2.1 Carrier Oscillator. Connect the VTVM to the center arm of the carrier-balance potentiometer, R25. A reading of 1 volt rms or more indicates correct oscillator operation.

2.2 Doubler and Doubler/Tripler Alignment. Connect a VTVM to the cathode of CR9. A reading of 0.5 to 0.6 volts indicates correct operation. Test with USB-LSB switch in both positions. If reading is low, align both slugs of T4 for maximum output. Switch to USB and align both slugs of T5 for best output. Switch to LSB and adjust the two X2 ADJUST trimmers for maximum. If readings are high, detune the bottom slug of T4 slightly until reading is correct. If only the LSB reading is high, detune one of the X2 ADJUST trimmers slightly.

2.3 VFO Alignment. Faulty VFO operation is indicated when dial readings cannot be corrected by the DIAL CORRECT knob, or no receiver operation is obtained on any band. Test for VFO oscillation by connecting the VTVM to the rear lug of the small 3-gang tuning capacitor. A reading of approximately 1.0 volt rms is normal. Test the VFO buffer by connecting the VTVM to the collector of Q14. Adjust the VFO buffer coil L4 for a reading of 0.12 volts rms.

To adjust the VFO frequency, set the DIAL CORRECT knob with pointer up and the PITCH switch to OFF. Tune the receiver to a signal of an accurate, known frequency (or use 100-kc calibrator) and adjust the VFO trimmer, C-54 until the signal is zero beat at the correct dial reading.

2.4 Receiver Zero Adjustment. Loosely couple the antenna lead of a stable full-coverage receiver to L4. Tune the receiver in the range 5.50 - 5.75 mc until the VFO signal is heard. Press the microphone button and accurately zero beat the signal on the receiver. Release the microphone button and adjust the VFO ZERO potentiometer R58 until the signal is again zero beat. Press the button several times and check to see that no detectable shift in VFO frequency occurs between receive and transmit.

NOTE: This adjustment will only hold across the dial if the VFO is properly aligned in accordance with paragraph 2.3 above.

2.5 Crystal Oscillator Alignment. Connect the VTVM to the emitter of either Q9 or Q10. Set the bandswitch to 15 meters. Adjust the slug of L6 for a meter reading of 0.25 volts rms. If this reading cannot be obtained, a reading between 0.2 and 0.3 volts is satisfactory. Now set the bandswitch to 20 meters and adjust the rear crystal trimmer (next to bandswitch) for a meter reading of 0.25 volts. Next, set the bandswitch to 40 meters and adjust the center trimmer for 0.25 volts. Finally, set the bandswitch to 80 meters and adjust the forward trimmer for 0.25 volts.

2.6 Receive RF Amplifier Alignment. Set the bandswitch to 15 meters and adjust pointer to the center of the 15-meter arc. Connect a signal generator to the antenna jack J5 and set for operation at 21.35 mc unmodulated. Reduce the attenuator as required so that an audio output signal of less than 0.25 volts (measured on the rear-panel speaker terminals) is obtained at full volume

control setting. Adjust the PA TUNE and PA LOAD controls for maximum audio output. Then adjust the center trimmer C90-B of the large 3-gang capacitor for maximum audio output. Then set the transceiver to receive on 3.80 mc and adjust the signal generator to 3.80 mc. Reset PA TUNE and PA LOAD controls for maximum audio output. With the attenuator set for an audio output of less than 0.25 volts, set the bandswitch knob index to a point 1/4" from the clockwise edge of the 80-meter arc. Adjust the center slug (L3) on the slug rack for maximum audio output. Use a long, non-metallic screwdriver for this adjustment.

2.7 Transmitter Bias Adjustment. Key transmitter with no drive, METER switch in Ip position. Adjust bias control, located in the upper right corner of the tube compartment, for a meter reading of 100 ma. This sets the final amplifier bias.

2.8 T2 Alignment. Set the transceiver to transmit on 3.80 mc. Connect a suitable 50-ohm dummy load to the antenna jack J5. Also connect the VTVM to the antenna jack. Connect a two-tone test signal into the microphone jack J1 and with the microphone button pressed, tune the transmitter controls for maximum power output with MIC GAIN control advanced slightly. Then reduce the MIC GAIN setting until the output is about 30 volts. Adjust T2 (one slug) for maximum output.

2.9 T3 Alignment. With the conditions set up for Step 2.8, adjust both slugs of T3 for maximum output.

2.10 T6 Alignment. With the conditions set up for Step 2.8, tune the transceiver to 3.90 mc. Repeak the bandswitch knob, the PA TUNE control and the PA LOAD control for maximum output. Then adjust both slugs of T6 for maximum output.

2.11 High-Frequency Mixer Alignment and Transmitter Drive Adjustment. With the conditions set up as in Step 2.8, set the transceiver to transmit at 21.35 mc and adjust the transmitter controls for maximum output. Set the bandswitch knob to the center of the 15-meter arc. With the MIC GAIN control set for an output of about 45.0 volts, adjust the forward trimmer, C90-A, of the large 3-gang capacitor for maximum output. Also adjust the rear trimmer, C90-C, for maximum output. If a large change in this trimmer is noted, it may be necessary to re-neutralize the power amplifier.

2.12 Transmitter Final Amplifier Neutralization. With conditions set up as outlined in Step 2.8, advance the MIC GAIN control until flat-topping occurs. Adjust the neutralizing capacitor C86 until maximum output and minimum plate current occur at the same setting of the PA TUNE control. There is some interaction between the neutralizing capacitor C86 and the drive trimmer C90C;

therefore C90C (rearmost trimmer) should be adjusted for maximum output per Step 2.11 before attempting to adjust the neutralizing capacitor.

2.13 Now set the transceiver to transmit at 3.80 mc and adjust controls for maximum output. Set the MIC GAIN control for about 30-volts output. Set the bandswitch knob index at a point 1/4" from the clockwise edge of the 80-meter arc. Adjust the front slug (L2) of the slug rack for maximum output. Also adjust the rear slug for maximum output.

2.14 Finally, set the transceiver to transmit at 7.20 mc and adjust controls for maximum output, release the microphone button and see that maximum receiver noise occurs at the same setting of the bandswitch knob as transmitter maximum output. If not, adjust the rear slug (L7) very slightly until the two settings are very nearly the same. Check 80-meter operation again and see that the bandswitch knob settings for maximum receiver noise and transmitter output are very nearly the same.

2.15 L10 Alignment. This adjustment reduces the spurious radiation of a signal at 24,625 kc, the frequency of the crystal oscillator when operating on 15 meters. Set for transmit on 21.35 mc and adjust for maximum transmitter output. Then set the MIC GAIN control fully counter-clockwise and adjust the VTVM to read the residual output signal. Slowly turn the PA TUNE control clockwise until a small peak shows on the VTVM. Adjust the slug of L10 for minimum reading. The final reading should be less than 1.0 volt rms. Return the PA TUNE control to the setting for maximum 15-meter output.

2.16 Carrier Balance. After completing Step 2.15, again reduce the MIC GAIN setting to zero. Alternately adjust the Carrier Balance potentiometer R25 and the Carrier Balance trimmer C23 for minimum output. It should be possible to null the carrier to a VTVM reading of less than 0.2 volt with the USB-LSB switch in either position. This completes the alignment procedure. Incorrect adjustment of T2 can affect carrier balance.

2.17 Voltage Regulator Adjustment. R42, the voltage regulator adjustment, has been carefully set at the factory and should not normally be adjusted in the field. If replacement of either Q18 or CR10 necessitates re-adjustment, the following procedure should be used.

Note: In addition to the test equipment listed on the preceeding page, a variac will be required for accurate voltage regulator adjustment.

Tune the receiver to a calibrator signal or other stable source. Vary the AC input line voltage between 100 and 120 volts while adjusting R42 for a steady signal. The voltage regulator is properly adjusted when the signal stability is unaffected by the line voltage fluctuations.

When the VOLUME control approaches the fully clockwise position, diode CR1, connected to the base of Q3, begins to limit the amount of audio applied for AGC action. With this occuring, more audio output is produced for a given amount of AGC. Finally, with the volume control fully clockwise, the base of Q3 is clamped off and full audio output is produced.

Diode CR2, in the collector of Q3, conducts when the unit is switched to transmit. This conduction charges the 250 mfd capacitor to the 12-volt potential so that when the set is switched back to receive, full receiver gain is instantly available.

3. KEYING CIRCUIT

Two transistors, Q16 and Q17, perform the functions necessary to switch the transceiver from receive to transmit, thus eliminating the conventional relay. The base of Q16 is coupled through a current limiting resistor to the cathode of driver tube V1. With the microphone button released, V1 draws no cathode current and its cathode is at ground potential. Q16, therefore, is cut off and the potential at its collector is +12 volts. This potential is supplied to the control line that requires +12 volts on receive. Also, the collector potential at Q16 is applied to the base of Q17 causing this transistor to conduct to saturation. Its collector potential, therefore, is essentially grounded. The control line requiring ground potential on receive is connected to the collector of Q17.

When the microphone button is pressed, the high negative bias on driver tube V1 is removed and the stage conducts. The cathode potential of V1 rises to approximately +6 volts and, with this voltage applied to the base, transistor Q16 conducts to saturation. The control line that was +12 volts on receive is now at ground potential. In addition, since the potential on the base of Q17 is removed, this stage cuts off and the control line that was grounded on receive is now +12 volts.

4. POWER SUPPLY

The SB-34 contains a power supply designed to operate from either 117-volts AC or 12-volts DC (negative ground). Inserting the appropriate power cord into the rear-panel receptacle makes the necessary connections to operate the supply in either mode.

With DC operation, transistors Q21 and Q22 are connected as a common-emitter power oscillator. Starting bias for this oscillator is obtained from a small resistor and the heater current of driver tube V1. All of the transmitter-tube heaters and input voltage to the oscillator are applied through the XMTR switch so that the receiver portion of the transceiver may be operated with reduced

3.2 PRELIMINARY CHECKOUT

Control settings:

Volume----------Fully CCW
Pitch Switch----------Off
Pitch Control----------Center of Range
Dial Correct----------Center of Range
Mic Gain----------Fully CCW
PA Load----------Fully CCW
PA Tune----------Fully CCW
USB/LSB----------USB
Tune/Operate Sw---------Operate
Meter Switch----------Ip

1. Plug unit in to variac and apply power - adjust variac to 120 vac.
2. Turn volume control on. Total line current should not exceed .7 amp.
3. Advance colume control to full CW. Adjust bandswitch for a noise peak on 40 meter band.
4. Connect dummy load, scope, VTVM, and two tone test signal.
5. Key the transmitter
6. Advance mic gain halfway and tune transmitter as described in "Operation" section.
7. This completes the preliminary checkout.

3.21

1) If total line current exceeds .7 amps, a short circuit probably exists. See trouble shooting chart "Excessive Line Current". If no short exists, check to see that the transmitter is not being keyed by either front panel controls, grounded - 70V line, or faulty keyers.

2) If no noise peak is obtainable, see trouble shooting chart "No Noise Peak". The audio curcuit may be quickly checked by placing one finger on the base of Q-2 and briefly touching your other hand to the collector of Q-20 (audio power amp). A loud squeal will result if the circuit is operating.

3) If the transmitter fails to key, refer to the trouble shooting chart "Transmitter Will Not Key". A meter indication of 100 ma will indicate proper idle current of the PA Tubes.

4) If the plate current can not be peaked by the exciter tune or no increase is evident as mic gain is advanced, refer to trouble shooting chart. If the receiver has already been checked and is operating properly, the possibility of faulty oscillators may be eliminated. The voltages in the trouble shooting chart are approximate and are measured with bandswitch control on receive noise peak.

5) Once the preliminary checkout has been completed, it may be assumed that the unit has been cleared of any Basic troubles. Specific troubles will be covered as the alignment procedure is performed. It is recommended that the receiver alignment is performed first even if the complaint is in the transmitter. This will insure correct adjustment of the various injection oscillators and if transformers which is necessary for proper transmitter alignment.

3.2.2 TROUBLESHOOTING GUIDE

Complaint or Symptom	Probable Cause	Component
Excessive Line Current	B+ short-Check to see that HV Test point is 50 kΩ in 10 seconds	
	Power inverter short	Q 21, Q22-C67,C68
No Noise Peak	456 OSC-Testpoint (1) should be at least 1.0 volts rms	Y 1, Q-12
	Doubler-Doubler/Tripler-Test point (2) should be at least .5 volts	Check alignment, Q-13, CR 8
	VFO-Test point (3) should be at least .12 volts	Q15, Q14 L-4 Misaligned
	HF OSC - Testpoint (4) should be at least .2 Volts	Q19, L6 misaligned. Poor ground on pc Board
	Keyers open-Test points (5) & (6) should be: (5) .2 VDC or less (6) 12 VDC Minimum	Q 16, Q 17
	Shorted Mixer Transistor	Q7, Q8, Q9, Q10
	Shorted 456 amp.	Q5, Q6
	Defective audio ckt	Q2, Q1, Q20 (Q-4 shorted)
No noise peak on one Band	No High Freq. oscillator injection on the applicable Band Tp(4)	Y2, Y3, Y4, Y5 Alignment of C80, C81, C82 or L6
Transmitter will not key	Defective Keyer	Q 16
	V1 not conducting/70V Line not grounded	V 1 Microphone
	No Bt to V-1	B + supply
Transmitter Keys but will not tune	No RF Drive TP 10: MIC amp inoperative-check for a change from 0-.2 VAC as mic gain is rotated from min. to max. TP 11: 456 kc amp inoperative-check for a change from 0-2 vac as mic gain is rotated from min. to max.	TP 12,13,14,10,11. Q-5

Complaint or Sympton	Probable Cause	Component
Transmitter keys, but will not tune	TP 12: VFO Mixer inop - Check for a change from 0-.25 vac as mic gain is rotated from min. to max.	Q 7
	TP 13: HF Mixer inoperative-Check for a change from .2 to 1.8 vac as mic gain is rotated from min. to max.	Q 9
	TP 14: Driver inoperative -set mic gain control for max-Check for up to 15 vac R-F	V 1, C-90C, L 7, L14
	OutPut Connector: PA ckt inoperative with mic gain set at max. check for up to 54 VAC R-F	V2,V3, C78, C76, L9, S7

3.3 ALIGNMENT SECTION

If, in following this procedure, a specified voltage can not be obtained or a condition satisfied, refer to that section of the "Alignment Trouble Shooting Chart" which corresponds to the number preceeding the alignment step. Check to see that the controls are set as follows:

Volume----------Fully CCW
Pitch Switch----------Off
Pitch Control----------Center of Range
Dial Correct----------Center of Range
Mic Gain----------Fully CCW
PA Load----------Fully CCW
PA Tune----------Fully CCW
USB/LSB Switch----------USB
Cal Switch----------Cal
xmtr Switch----------xmtr
Tune/Oper----------Oper
Meter Switch----------Ip

Set internal adjustments for the following positions only if previous alignment has been attempted or the unit has been tampered with:

Bias pot (R-8L) - Fully CCW (Located inside PA cavity)
Regulator control (R-42) - Center of range (Located on left rail)
Receiver zero pot (R-58) - Center of Range (Under chassis below VFO Board)
Neutralizing cap (C-86) - Screw end to be 5/8" from mounting surface
Tuner slug screws - Screw end 1/8" from edge of rack
24 mc trap (L-10) - Slug even with edge of terminal ring

3.3.1 PROCEDURE

3.3.1.0 VOLTAGE TESTS - Turn volume control to ON.
3.3.1.1 Measure voltage at Red Bus on Tuner Board. With input voltage, set at 120 volts, Red Bus voltage shall be 11 vdc minimum.
3.3.1.2 Measure voltage at Gray Bus on Tuner Board. Shall be 11 vdc minimum.
3.3.1.3 Measure voltage at Blue Bus on Tuner Board. Shall be 0.2 vdc maximum.
3.3.1.4 Measure voltage at Purple Lead on Tuner Board. Shall be -70 v minimum.
3.3.1.5 Measure voltage on Plates of PA Tubes. Shall be 480 vdc minimum.

3.3.2.0 RECEIVER ALIGNMENT - VTVM refers to HP-410B using R-F probe.
3.3.2.1 Connect VTVM to TP 1 (center of carrier balance pot). Voltage shall be 1. volt minimum.
3.3.2.2 Connect VTVM to collector of Q-13. Align both slugs of T4 for maximum reading. Make sure that slugs are on outside of coils.
3.3.2.3 Connect VTVM to TP 2 (IF Board). With USB/LSB switch in USB position, align both slugs to T-5 for maximum reading. Then switch to LSB and align both mica compression trimmers (C32 & C33) for maximum output. If the reading with the switch in LSB exceeds .5 volts, screw the bottom slug of T-4 into the coil until a reading of .5 volts is obtained. Place switch in USB position and note the reading. If this reading is less than .6 volts, screw the bottom slug of T-4 out of the coil until .6 volts is obtained. Switch to LSB and adjust C-33 until a reading of .5 volts is obtained. If ~~the use~~ This reading exceeds

.6 volts, screw the top slug of T-5 out of the coil until .6 volts is obtained. (If this adjustment is required, retune the mica compression trimmers with the switch in LSB, for maximum output). Final output voltages should be .6 volts for USB and .5 volts for LSB.

3.3.2.4 Set the tuning dial to 7.15 mc (40 meters). Connect the VTVM to the rear stator lug of the small 3 gang capacitor (C48-C). A reading of .5 to .8 volts indicates correct VFO operation.

3.3.2.5 Connect the VTVM to the rear inboard lug of L-4 (TP 3). Screw L-4 slug to the clock-wise limit and then counter-clock-wise until a reading of .12 volts is obtained.

NOTE: In units with chassis # 12 or below, this reading may only decrease to .4 volts.

3.3.2.6 Loosely couple the antenna of monitor receiver to the VFO output. (Recommend clamping alligator clip over C-43). Check to see that dial reading of unit under test reads between 7.15 and 7.2. Adjust the monitor receiver until a beat note is heard (approximately 200 cps). Vary the line input variac between 95-120 vac. Adjust the regulator control (R-42) so that the beat note remains the same as the variac is swung from 95-120 vac.

3.3.2.7 Put the set in tune position. If the beat note changes, adjust the monitor receiver as required to return it to 200 cps. Check to see that the pitch switch is off. Unkey the transmitter and adjust the receiver zero pot (R-59) until the beat note is the same as with the transmitter keyed. Key and unkey the transmitter several times to assure that beat note remains the same.

3.3.2.8 With the transmitter unkeyed, turn the pitch on. See that the pitch control will vary the beat note at least 300 cps above and below the note obtained with the transmitter keyed. Turn off pitch switch.

3.3.2.9 With the transmitter keyed, test the dial correct control. It should be possible to vary the beat note at least 1500 cycles above and below the note obtained with the dial correct knob centered. Remove the monitor receiver hookup. Unkey the transmitter.

3.3.2.10 Connect VTVM to TP 4 on the high frequency oscillator board. Turn the bandswitch to 15 meters. Adjust coil slug (L-6) for a meter reading of .24 volts. (NOTE: The slug will usually tune out of the coil for this reading in units with chassis numbered 20 and above - refer to modification section). Turn the bandswitch to 20m and back to 15m several times to make sure that the oscillator starts reliably.

3.3.2.11 Turn the bandswitch to 20 meters and adjust C-80 trimmer (located in PA cavity) for a reading of .24 volts.

3.3.2.12 Turn the bandswitch to 40 meters and adjust C-81 for a reading of .24 volts.

3.3.2.13 Turn the bandswitch to 80 meters and adjust C-82 for .24 volts. Check to see that the oscillator starts reliably on all bands and that output on all bands is .24 volts. Remove the VTVM leads.

14 Connect the SIGNAL GENERATOR leads to the antenna jack and an AC voltmeter to the external speaker terminals on the rear panel. Set the bandswitch knob to the center of the 15 meter arc. Set the tuning dial to 21.30 mc. Tune the signal generator (with modulation off) near 21.30 mc until a beat note is heard. Adjust signal generator attenuator for an audio output meter reading of .2 volts or less with volume control fully clock-wise. Adjust the PA tune and PA load controls for maximum audio output. Peak the front and center trimmers on the large 3 gang capacitor (C 90 A & B) for maximum output. Reduce the generator output as required to keep audio meter reading below .2 vac. Tune both slugs of T-3 and T-6 and the single slug of T-2 for maximum output. Final audio output shall be 1 volt for an input of 1 microvolt. If the required sensitivity is achieved, proceed to 3.3.2.15.

NOTE: The following readings are approximate and should be used only as a general guide in locating a weak stage. The generator used had 50 OHMS output and a .03 MFD isolating capacitor on the signal input line.

3.3.2.14.1 Connect signal generator to the base of Q-6. Adjust generator around 456 kc until a beat note is heard. With 15 microvolts ± 30% input at this point, .5 volts audio should appear at the speaker output.

3.3.2.14.2 Connect signal generator to the base of Q-8. Adjust generator between 3175 kc and 3425 kc until a beat note is heard. With 7.5 microvolts ± 40% input, .5 volts audio should appear at the speaker output terminals.

3.3.2.14.3 Connect signal generator to the base of Q- 10. Adjust generator to dial frequency until a beat note is heard. With 1.1 microvolts, ± 40% input, 1 volt should appear at the speaker output terminals.

3.3.2.14.4 Connect signal generator to antenna input jack. Adjust generator to dial frequency until a beat note is heard. With 1 microvolt input, 1 volt should appear at speaker output terminals.

3.3.2.15 Set bandswitch to 80 meters with index 1/8" from the clock-wise edge of the 80 meter arc. Set the tuning dial to 3.80 mc. Adjust the signal gererator near 3.8 mc until a beat note is heard. Reduce attenuator as required to keep audio down to .2 volts. Adjust the center and front slugs on the tuner board (L-2 and L-3) for maximum audio output. Adjust PA load and PA tune controls for maximum output. Final audio output shall be 1.5 volts for an input of 1 microvolt.

3.3.2.16 Check 40 meter receiver operation by tuning set and signal generator to 7.10 mc and adjusting bandswitch, PA load and PA tune controls for maximum output. Final audio output shall be 1 volt for an input of 1 microvolt.

3.3.2.17 Check 20 meter receiver operation by tuning set and signal generator to 14.2 mc and adjusting bandswitch, PA load and PA tune controls for maximum output. Final audio output shall be 1.5 volts for an input of 1 microvolt.

3.3.2.18 This completes receiver alignment. Remove signal generator and audio output meter leads.

3.3.3.0 TRANSMITTER ALIGNMENT - Readings taken with HP-410B

3.3.3.1 Connect dummy load to antenna jack. Connect VTVM across antenna jack. Adjust scope for clean two-tone output @ .015 volts. Set frequency to 21.30 mc. Set bandswitch to 15 meters and adjust to the point of maximum receiver noise.

3.3.3.2 Key the transmitter. With the mic gain control fully CCW, adjust the bias pot (R-81) for a total line current of 1.2 amps (plate current meter should read between 1. and 1.5).

3.3.3.3 Advance the mic gain control to mid scale, set PA tune CCW, and adjust the rear trimmer on the large 3 gang capacitor (C-40c) for maximum front panel meter reading. If the scope pattern shows signs of self oscillation at this point, adjust the neutralizing capacitor (C-86) as required to prevent it.

3.3.3.4 Adjust the PA tune and PA load controls for maximum transmitter output, and advance the MIC gain control as required to keep the transmitter scope pattern at the point of flat topping. (NOTE: always approach PA resonance from the CCW position. The output obtained at the extreme CW position of the PA tune control is incorrect). If signs of instability show, readjust the neutralizing cap as required. Adjust slightly the front trimmer of the large 3 gang capacitor (C-90A) for maximum output. After the above mentioned adjustments have been completed, with the mic gain set just at the point of flat-topping, the VTVM shall read at least 45 volts rms with 120 volts line voltage. If the required output is achieved, proceed to 3.3.3.5.

NOTE: The following readings are approximate. Keep in mind that a lower than average reading from a particular stage may be compensated for if the following stages have higher than average gain. Tune transmitter for maximum output, then rotate PA tune fully CCW before taking readings. Don't leave transmitter keyed in this condition for more than 30 seconds.

3.3.3.4.1 With the transmitter keyed, check for .26 volts AC ± 40% at TP 10. If this reading is obtained, adjust mic gain control so that TP-10 is .2 volts and go to 3.3.3.4.2

3.3.3.4.2 Connect VTVM to TP 11 (Filter Input). Check for 1.9 volts AC ± 20%.

3.3.3.4.3 Connect VTVM to TP 12. Check for .26 volts AC ± 30%.

3.3.3.4.4 Connect VTVM to TP 13. (Driver tube grid). Check for 1.9 volts RF ± 15%

3.3.3.4.5 Connect VTVM to TP 14 (PA tube input). Check for 15.5 volts RF ± 15%

.4.6 Connect VTVM across output connector. Voltage should be at least 45 volts RF.

TURN THE MIC

3.5.3.5 Turn the MIC GAIN CONTROL fully counter-clockwise and adjust the PA tune control clockwise until a peak occurs on the VTVM. Then adjust L-10 (24 mc trap) for minimum VTVM reading. This reading should be 2.0 volts or less.

3.3.3.6 Return the PA tune control to previous setting and tune transmitter to the point of flat-topping. Adjust neutralizing capacitor C 86 until maximum output and minimum plate current occur at the same setting of the PA tune control. In order to determine the correct direction in which to turn the neutralizing capacitor, the following test may be made: Dip the plate current. Then rotate the PA tune control in the direction which produces maximum VTVM reading. If this direction is clockwise, the neutralizing capacitor must also be rotated clockwise.

3.3.3.7 Turn the mic gain control fully counter-clockwise and adjust the carrier balance pot R-25 and trimmer capacitor C23 for minimum VTVM reading. The final reading should be .4 volts or less with the USB/LSB switch in either position.

3.3.3.8 Set the Bandswitch knob to 40 meters on receive noise peak. Set the tuning dial to 7.075 mc. Advance the mic gain to mid scale, and adjust the rear slug on the slug rack for maximum VTVM reading. Adjust the PA tune and PA load controls for maximum VTVM reading advancing the MIC gain control as required to keep the scope pattern at the point of flat-topping. After completing the above adjustments, with the MIC gain control advanced to the point of flat-topping, the VTVM reading shall be at least 54 volts with 120 volts line voltage.

3.3.3.9 Test 80 meter operation by adjusting the bandswitch knob on noise peak and PA TUNE and PA LOAD controls for maximum output at 3.8 mc. The bandswitch knob setting must coincide very closely with the setting that produces maximum receiver noise. If necessary, a compromise rear-slug setting must be made to provide good receiver sensitivity and transmitter drive at the same setting of the bandswitch knob on both 40 and 80 meters. After completing the adjustments, with the MIC GAIN control advanced to the point of flat-topping, the VTVM reading on 80 meters shall be at least 50 volts with 120 volts line voltage.

3.3.3.10 Test 20 meter operation by adjusting the bandswitch knob for maximum drive and the PA LOAD and PA TUNE controls for maximum output at 14.25 mc. The bandswitch knob setting must coincide very closely with the setting that produces maximum receiver noise. With the PA TUNE and PA LOAD controls adjusted for maximum output, there shall be no signs of transmitter instability. Readjust the neutralizer as required on 20 meters to obtain stable operation and a clean two-tone pattern on the scope. Transmitter output with 120 volts line voltage and the MIC GAIN control set at the point of flat-topping shall be 54 volts minimum on 20 meters.

3.3.3.11 Test to see that transmitter output is equal with the USB/LSB switch in either position. Test operation of the TUNE/OPER switch by turning the microphone test plug switch off and setting the TUNE/OPER switch to TUNE. The scope pattern should be a solid bar with output essentially equal to that obtained with a two tone test signal.

3.3.3.12 Measure voltage at linear amp receptacle on rear panel TP 15. Voltage should be approximately 12 volts DC when the transmitter is keyed. 12

3.3.3.13 Attach the 100 kc crystal calibrator to the rear panel receptacle. Place the USB/LSB in USB. Check to see that the pitch switch is OFF and the dial correct is in the center of its range. Turn the cal switch to ON. Set the band switch to 15 meters and adjust for maximum noise. Set frequency below 21.20 mc. Rotate the frequency dial toward 21.20 mc. A beat note should be heard near 21.20 and should zero on the frequency dial mark for that frequency. Adjust C-54 until this result is obtained. Advance dial and listen for the next beat note at 21.30 and 21.40. Do not readjust C-54. Check 20M, 40M and 80M 100 kc points.

CRY
6900

3.3.4.0 Connect unit to 14.6 volt DC source with proper power cord. See that receiver operation is normal. Turn the "xmtr switch" to ON. The power inverter should start and tube filiaments should come on. A buzz from the speaker is normal when the inverter is operating.

3.3.4.1 Test the transmitter operation. The output should be essentially the same as with AC operation. 14.6 volts line input should be measured <u>at the set</u> when making transmitter power measurements in DC operation.

3.4 ALIGNMENT TROUBLE SHOOTING CHART

Unable to obtain requirement at step #		Check
3.3.1.2	Indicates Faulty keyer	Q 16
3.3.1.3	Indicates Faulty keyer	Q 17
3.3.1.4	Indicates improper bias voltage	Bias supply, shorted tubes
3.3.1.5	Indicates faulty B + supply	
3.3.2.1	Insufficient output from 456 kc osc.	Q12, Y1
3.3.2.2	No reading indicates faulty doubler	CR-8,T-4 Q-13
3.3.2.3	Unable to obtain correct readings	T-5, Q-13
3.3.2.4	IF reading exceeds 1. volt, change	Q-15
3.3.2.6	Unable to obtain flat beat note	CR-10,Q-18
3.3.2.7	Unable to obtain flat beat between TX & RX	CR-12,CR-13
3.3.2.8	Pitch control limited range or inoperative	CR-11,S-3 R-59
3.3.2.9	Dial correct limited range or inoperative	CR-11,R-60
3.3.2.10	Crystal osc inoperative or low output	Poor ground on PC Board Q19,Y5,L6
3.3.2.11	20 meter injection low or inoperative	Y4
3.3.2.12	40 meter injection low or inoperative	Y3
3.3.2.13	80 meter injection low or inoperative	Y2
3.3.2.14	Sensitivity low	
3.3.2.14.1	Insufficient gain in 456 amp or audio ckts. Note: to check agc circuit, remove Q-3 and note output meter. If the reading increases, fault is in the agc circuit	Q6,Q2,Q1, Q20,C16, C10,Q3,C2, C8
3.3.2.14.2	Insufficient conversion gain	Q8,T6,T3, CR 9
3.3.2.14.3	Insufficient conversion gain	Q10,Q11, L2, T6
3.3.2.14.4	Insufficient RF amplification	Q11,C 3 CR 14,15
3.3.2.15-2.17	IF readings cannot be obtained, recheck alignment	
3.3.3.2	PA Idle current low	V-2 V-3
3.3.3.3	Unit won't neutralize-Check to see that driver tube shield is making good ground	C 86, V2,V3
3.3.3.4.1	Check for adequate two-tone input Should be .015 volts.	Q4, Mod#6, C10,C6,C18
3.3.3.4.2	456 amp weak	Q5, T2
3.3.3.4.3	Insufficient conversion gain	Q7, T3,T6
3.3.3.4.4	Insufficient conversion gain from HF mixer or shorted Q11, Q10	Q9,Q10,Q11, V1,L2,L3, C90 A&B
3.3.3.4.5	Insufficient Drive from V1	V1, C90C L7
3.3.3.4.6	Low output Note: B+ should not go below 350 volts DC measured at the high voltage test point under full load	V2,V3, output Circuits, Low B+

3.4 ALIGNMENT TROUBLE SHOOTING CHART
(Continued)

Unable to obtain requirement at step #		Check
3.3.3.5	If a sharp dip cannot be obtained, replace L-10 or C-65. If dip is not low enough, try to neutralize first.	
3.3.3.6	Insufficient control from C86. Check first to see that driver tube shield is making a good ground.	C86,C90C Tuning, V2, V3
3.3.3.7	Excessive residual carrier. Any Stage producing noise sufficient to modulate the final amp will cause this reading to be higher than specified. Be sure that no audio is leaking into the unit while this measurement is being made. If no dip can be obtained with the carrier balance pot, change all the diodes in the balanced modulator	
3.3.3.11	No indication in tune	Faulty tune switch,C13 open
3.3.3.12	Continuous output	Q23 shorted
3.3.3.13	Dial non linear on one band.	Bend rear rotor plate on C48 accordingly.
	20, 40 or 80 doesn't fall within limits	Adjust appropriate crystal trimmer or replace crystal.
3.3.4.0	Inverter won't start	Q21, Q22, C67 C68, T7

3.5 TRANSISTOR VOLTAGES

Symbol	Type No.	Base	Emitter	Collector	Measured in
Q1	2N2431	10.7	11.1	0	Receive*
Q2	2N3638	10.3	11.0	7.9	Receive*
Q3	2N3642	0	0	11.1	Receive*
Q4	2N3638	10.7	11.5	8.1	Transmit
Q5	2N2672	12.1	12.4	0	Transmit
Q6	2N2672	10.3	10.6	0	Receive
Q7	2N2672	11.6	11.9	0	Transmit
Q8	2N2672	11.0	11.3	0	Receive
Q9	2N2672	12.5	12.8	0	Transmit
Q10	2N2495	12.0	12.2	0	Receive
Q11	2N2672	11.7	12.0	0	Receive
Q12	2N2672	10.5	10.1	.1	Receive
Q13	2N2672	12.8	12.6	0	Receive
Q14	2N2672	5.2	5.5	0	Receive
Q15	2N706	1.43	0.8	5.8	Receive
Q16	2N3642	-1.02	0	12.1	Receive
Q17	2N3642	.94	0	.12	Receive
Q18	2N2926	.58	0	7.1	Receive
Q19	2N2672	11.6	10.5	0	Receive **
Q20	2N2869/2N301	10.4	10.7	.63	Receive
Q21	2N443	14.5	12.8	10.0 AC	Receive
Q22	2N443	14.5	12.8	10.0 AC	Receive
Q23	2N2926	13.6	13.1	13.6	Transmit

Measurements taken with 20,000 ohms-per-volt meter, no signal input, set powered from 120 volt AC.
* Volume control full clockwise.
** On 20 m band

2N2672 = SK 3007A
2N2495 = SK 3006
2N2869/2N301 = SK 3009
2N2638 = Radio Shack # 2021 (MPS 2907)

TRANSISTOR VOLTAGES

Symbol	Type No.	Base	Emitter	Collector	Measured in
Q1	2N2431	10.7	11.1	0	Receive *
Q2	2N3638	10.3	11.0	7.9	Receive *
Q3	2N3642	0	0	11.1	Receive *
Q4	2N3638	10.7	11.5	8.1	Transmit
Q5	2N2672	12.1	12.4	0	Transmit
Q6	2N2672	10.3	10.6	0	Receive
Q7	2N2672	11.6	11.9	0	Transmit
Q8	2N2672	11.0	11.3	0	Receive
Q9	2N2672	12.5	12.8	0	Transmit
Q10	2N2495	12.0	12.2	0	Receive
Q11	2N2672	11.7	12.0	0	Receive
Q12	2N2672	10.5	10.1	0.1	Receive
Q13	2N2672	12.8	12.6	0	Receive
Q14	2N2672	5.2	5.5	0	Receive
Q15	2N3564	1.43	0.81	5.8	Receive
Q16	2N3642	-1.02	0	12.1	Receive
Q17	2N3642	.94	0	.12	Receive
Q18	2N2926	.58	0	7.1	Receive
Q19	2N2672	11.6	10.5	0	Receive **
Q20	2N2869/2N301	10.4	10.7	.63	Receive
Q21	2N443	14.5	12.8	10.0 AC	Receive
Q22	2N443	14.5	12.8	10.0 AC	Receive
Q23	2N2926	13.6	13.1	13.6	Transmit

Measurements taken with 20,000 ohms-per-volt meter, no signal input, set powered from 117-volt AC.

* Volume control full clockwise.

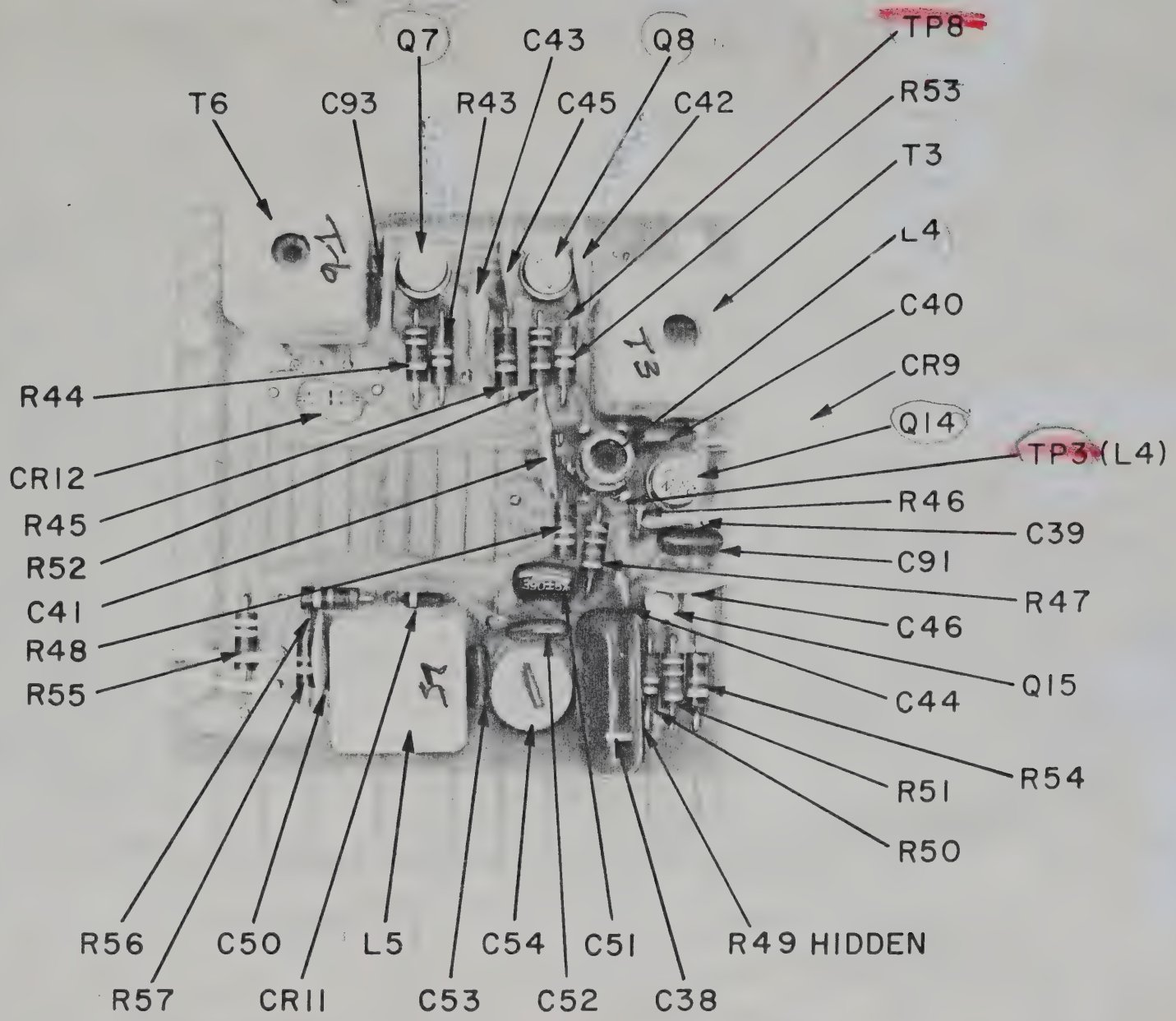
** On 20 m band

TUBE VOLTAGES

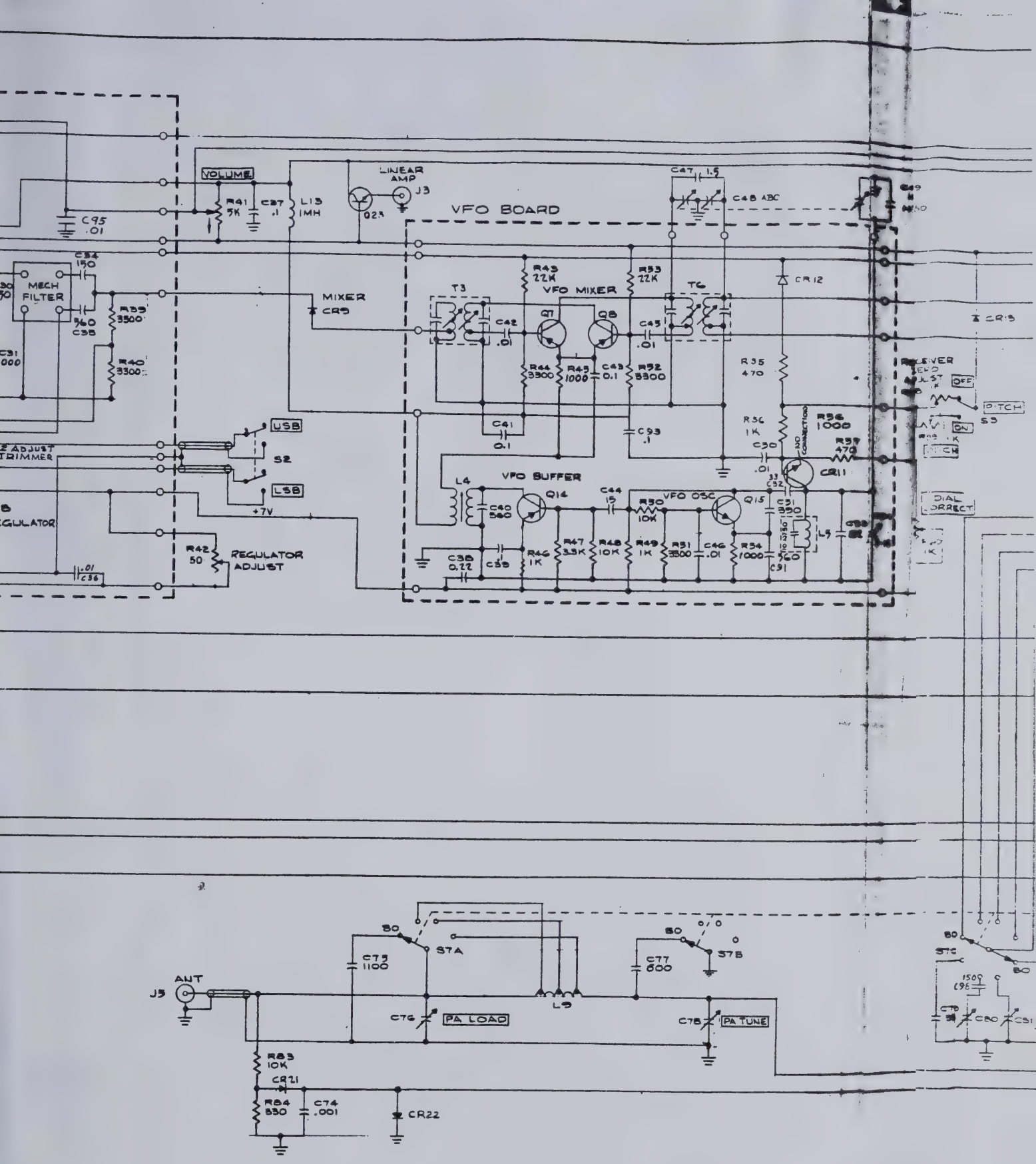
Tube	PIN NUMBER							
	1	2	3	6	7	8	9	Cap
V1	6	0	6		405	170	0	
V2, V3	-22	-22	0	150	150	0	-	405

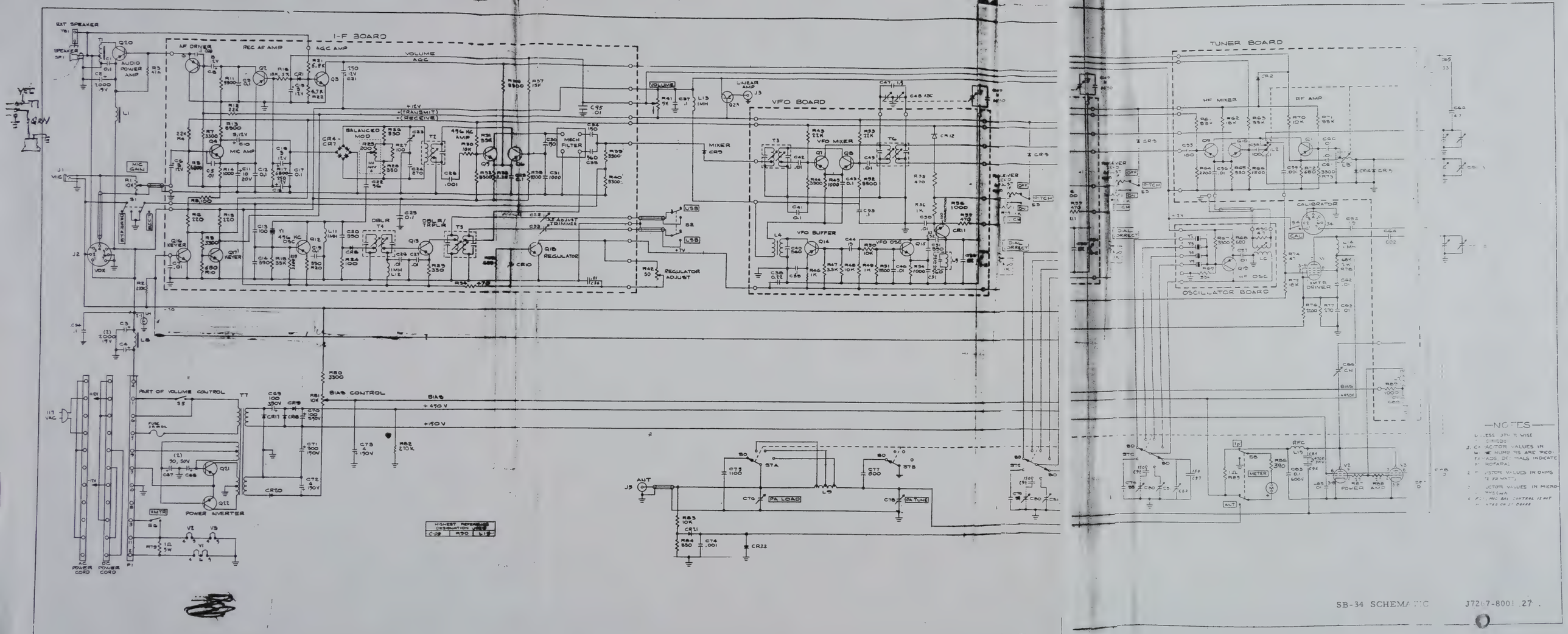
Notes:

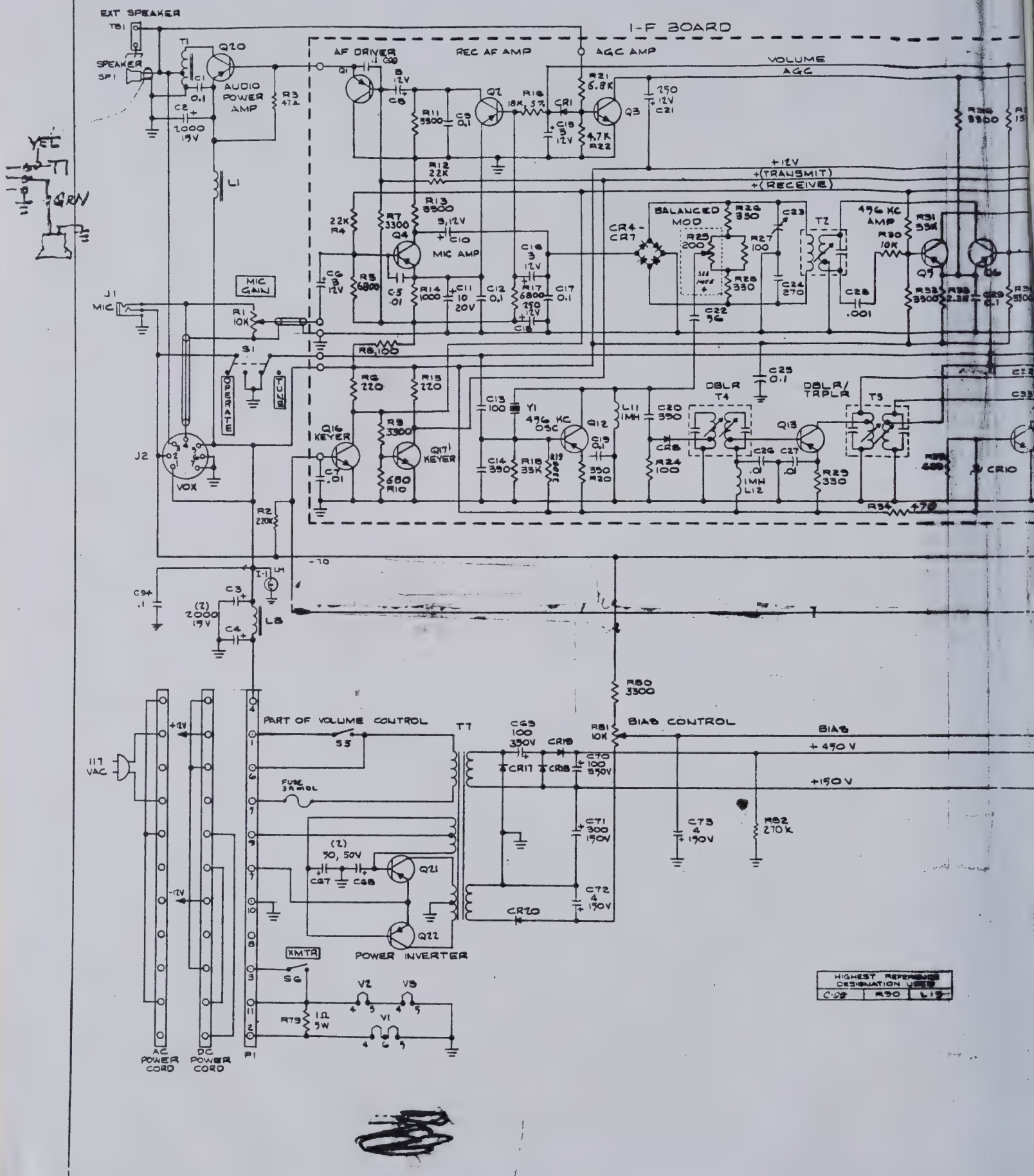
1. 6 V.D.C. between filament pins 4 & 5 of V2 & V3. V1 filament pins 4, 5 and 6.
2. All measurements made with 120 V.A.C. input, microphone button depressed.


Q7
C43
Q8
TP8
T6
C93
R43
C45
C42
R53
T3
L4
C40
CR9
Q14
TP3 (L4)
R46
C39
C91
R47
C46
Q15
C44
R54
R51
R50
R49 HIDDEN
C38
C51
C52
C53
C54
L5
CR11
C50
R57
R56
R55
R48
C41
R52
R45
CR12
R44

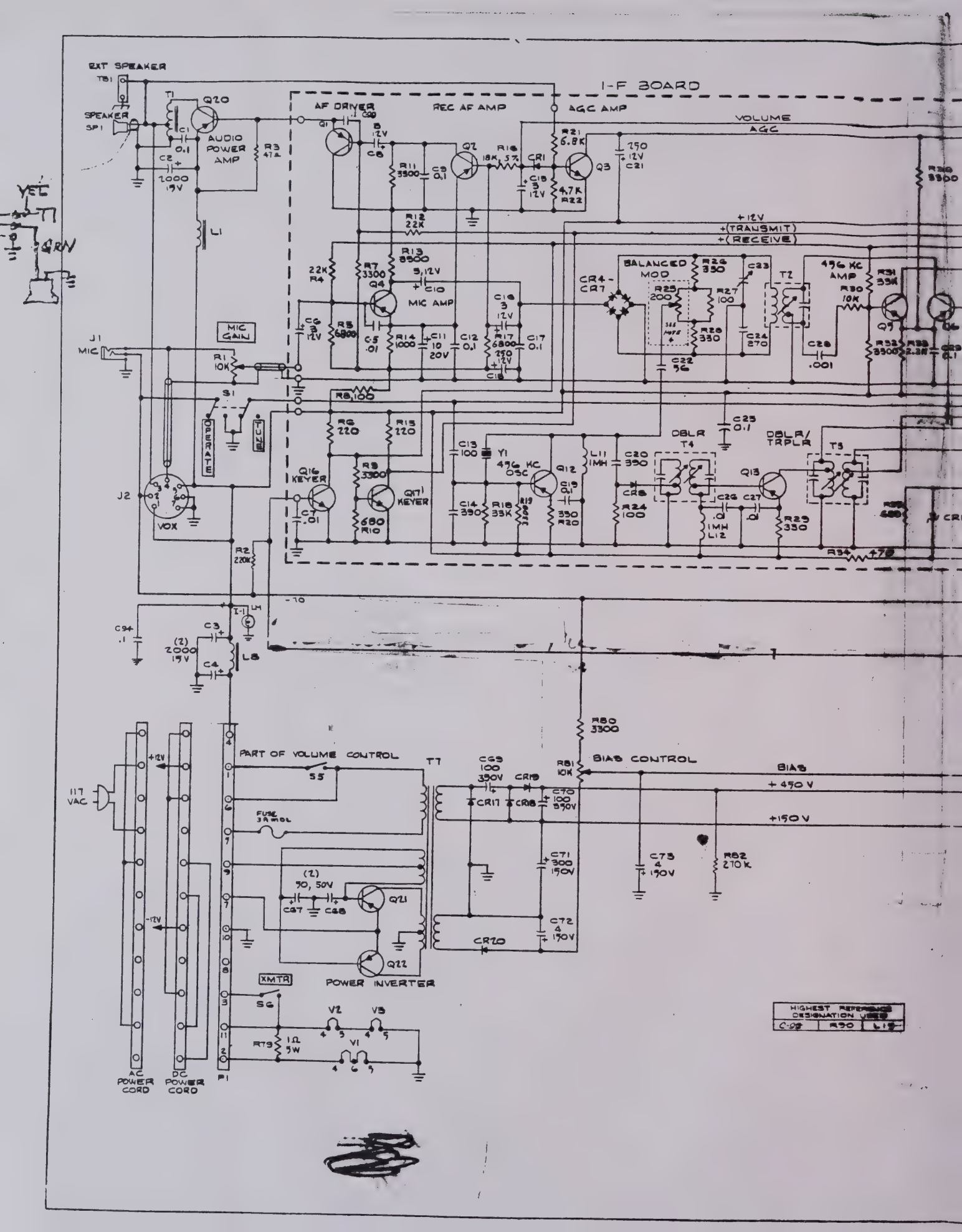
VFO BOARD


VOLUME
R41 5K
C37 .1
L13 1MH
LINEAR AMP
J3
Q23
VFO BOARD
C47 1.5
C48 ABC
C95 .01
C34 150
MECH FILTER
C35 360
R39 3300
R40 3300
MIXER
CR9
T3
R43 22K
VFO MIXER
R53 22K
T6
CR12
Q7
Q8
C42 .01
C45 .01
R44 3300
R45 1000
C43 0.1
R52 3300
R35 470
C41 0.1
C93 .1
R36 1000
R56 1K
C30 .01
R37 470
CR11
L4
VFO BUFFER
Q14
C44 15
VFO OSC
Q15
R50 10K
C40 560
R47 3.3K
R48 10K
R49 1K
R31 3300
C46 .01
R34 1000
C31 360
L5
C38 0.22
C39
R46 1K
USB
S2
LSB
+7V
R42 50
REGULATOR ADJUST
S3
PITCH
ON
OFF
DIAL CORRECT
ANT
J5
S7A
S7B
C75 1100
C77 600
C76
PA LOAD
L9
C78
PA TUNE
R83 10K
CR21
R84 330
C74 .001
CR22


EXT SPEAKER
SPEAKER
AUDIO POWER AMP
1-F BOARD
AF DRIVER
REC AF AMP
AGC AMP
VOLUME AGC
+12V (TRANSMIT) +(RECEIVE)
MIC AMP
BALANCED MOD
496 KC AMP
MECH FILTER
SSB ADJUST TRIMMER
REGULATOR
REGULATOR ADJUST
MIC GAIN
VOX
ANTI VOX
KEYER
DBL'R T4
DBL'R/TRPLR
496 KC OSC
MIXER
VOLUME
LINEAR AMP
VFO BOARD
VFO MIXER
VFO BUFFER
VFO OSC
CALIBRATOR
DIAL CORRECT
TUNER BOARD
RF MIXER
RF AMP
OSCILLATOR BOARD
HF OSC
MULTI DRIVER
PART OF VOLUME CONTROL
BIAS CONTROL
BIAS
+450 V
+150 V
117 VAC
POWER INVERTER
AC POWER CORD
DC POWER CORD
ANT
PA LOAD
PA TUNE
METER
RFC
NOTES


I-F BOARD
EXT SPEAKER
TB1
SPEAKER SP1
T1
Q20
AUDIO POWER AMP
R3 47Ω
C1 0.1
C2 2000 15V
L1
YEL
GRN
AF DRIVER
REC AF AMP
AGC AMP
VOLUME AGC
Q1
C5 3 12V
C6
R11 3300
C9 0.1
Q2
R16 18K 5%
CR1
R21 6.8K
Q3
C15 3 12V
R22 4.7K
C21 250 12V
R12 22K
+12V
+(TRANSMIT)
+(RECEIVE)
R4 22K
R7 3300
Q4
R13 8500
C10 3 12V
MIC AMP
C16 3 12V
R17 6800
C17 0.1
C18 250 12V
C6 3 12V
R5 6800
C5 .01
R14 1000
C11 10 20V
C12 0.1
MIC GAIN
J1 MIC
R1 10K
S1
OPERATE
TUNE
R8 100
R6 220
R15 220
R9 3300
Q16 KEYER
Q17 KEYER
R10 680
C7 .01
J2
VOX
R2 220K
BALANCED MOD
R26 350
R25 200
R27 100
R28 330
C22 56
C23
C24 270
T2
CR4-CR7
C28 .001
496 KC AMP
R31 33K
R30 10K
Q5
Q6
R32 3300
R33 2.2K
C29 0.1
C25 0.1
DBLR T4
DBLR/TRPLR T5
C13 100
Y1 496 KC OSC
Q12
L11 1MH
C20 330
CR8
R24 100
C14 390
R18 33K
R19 68Ω
C19 0.1
330 R20
Q13
C26 .01
C27 .01
1MH L12
R29 330
R34 470
CR10
-10
C34 .1
C3
(2) 2000 15V
C4
L8
R80 3300
PART OF VOLUME CONTROL
S5
T7
CR9 100 350V
CR8
R81 10K
BIAS CONTROL
BIAS
+450 V
+150 V
C70 100 350V
CR17
C71 300 150V
C73 4 150V
R82 270K
C72 4 150V
CR20
117 VAC
FUSE 3A MDL
(2) 50, 50V
C47
C48
Q21
Q22
POWER INVERTER
XMTR
S6
V2
V3
V1
R79 1Ω 5W
AC POWER CORD
DC POWER CORD
P1
HIGHEST REFERENCE DESIGNATION USED
C-98
R90
L19

Symbol	Stock No.	Description
		TUBES
V1	290-7247P2	12DQ7
V2, 3	290-7215P1	6GB5
		CRYSTALS
Y1	394-7189P1	456.38Kc
Y2	394-7185P1	7200Kc (80 meter)
Y3	394-7186P1	10475Kc (40 meter)
Y4	394-7187P1	17525Kc (20 meter)
Y5	394-7188P1	24625Kc (15 meter)
		MISCELLANEOUS
	7267-5005G1	Cabinet, complete w/handle
	7267-7012P1	Cable, DC, W-70
	7267-7013P1	Cable, AC, W-71
	7267-1065P1	Clamp, Mech. Filter
	7267-1045P1	Dial, Frequency
	7267-1027P1	Dial, Bezel
	7267-1028P1	Dial, Window
	7267-1047G1	Geneva Wheel assembly
	7251-1021G1	Geneva Plate assembly
	7267-1042P1	Grill, speaker
	231-7221G1	Handle, w/mounting clips
	231-7192P4	Knob, small round
	231-7196P2	Knob, large round, tuning
	231-7191P2	Knob, pointer, bandswitch
	369-7174P1	Mechanical Filter
	7267-1026P1	Panel, Front overlay
	7267-1035P1	Shaft, extension for C76
	7267-1063P1	Shield, top
	7267-1062P1	Shield, bottom
	7267-1064P1	Shield, VFO board
	386-7193P1	Socket, transistor, small
	386-7194P1	Socket, transistor, power
	282-7196P1	Socket, tube V-1
	282-7194P2	Socket, tube V-2-3
		Tuner Slug Assembly Parts
	297-7182P1	Ferrite slug (L-2-3-7)
	7251-1062P2	Slug connecting rod, nylon
	7267-1038P1	Yoke, wire
	7251-1024P1	Yoke Keeper, wire
	7251-1026P1	Yoke attachment bracket
	7267-1041P1	Vernier Drive, dual, ball
	7267-5016G2	I.F. Printed Circuit Board (less mechanical Filter)


I-F BOARD
EXT SPEAKER
TB1
SPEAKER
SP1
T1
Q20
AUDIO POWER AMP
AF DRIVER
REC AF AMP
AGC AMP
VOLUME AGC
Q1
Q2
Q3
R21 6.8K
4.7K R22
R12 22K
+12V
+(TRANSMIT)
+(RECEIVE)
R13 8500
R7 3300
Q4
MIC AMP
22K R4
R5 6800
R14 1000
R17 6800
BALANCED MOD
CR4-CR7
R26 350
R25 200
R27 100
R28 330
T2
496 KC AMP
R31 39K
R30 10K
Q5
Q6
R32 3300
R33 2.2K
C22 56
C24 270
C26 .001
J1 MIC
MIC GAIN
R1 10K
S1
OPERATE
TUNE
R8 100
R6 220
R15 220
R9 3300
R10 680
Q16 KEYER
Q17 KEYER
J2
VOX
R2 220K
C13 100
Y1 496 KC OSC
Q12
L11 1MH
C20 390
C19 .1
R24 100
R20 330
C14 390
R18 33K
C25 .1
DBLR T4
DBLR/TRPLR T3
Q13
C26 C27
L12 1MH
R29 330
R34
+7.5
-10
C94 .1
C3 (2) 2000 15V
C4
L8
R80 3300
PART OF VOLUME CONTROL
S5
T7
C69 100 350V
CR19
R81 10K
BIAS CONTROL
BIAS
+450 V
+150 V
CR17
CR18
C70 100 350V
117 VAC
FUSE 3 AMP
C71 300 150V
C73 4 150V
R82 270K
(2) 50, 50V
C47
C48
Q21
Q22
CR20
C72 4 150V
POWER INVERTER
XMTR
S6
V2
V3
V1
R79 1Ω 5W
P1
AC POWER CORD
DC POWER CORD
HIGHEST REFERENCE DESIGNATION USED
C-98
R90
L-12

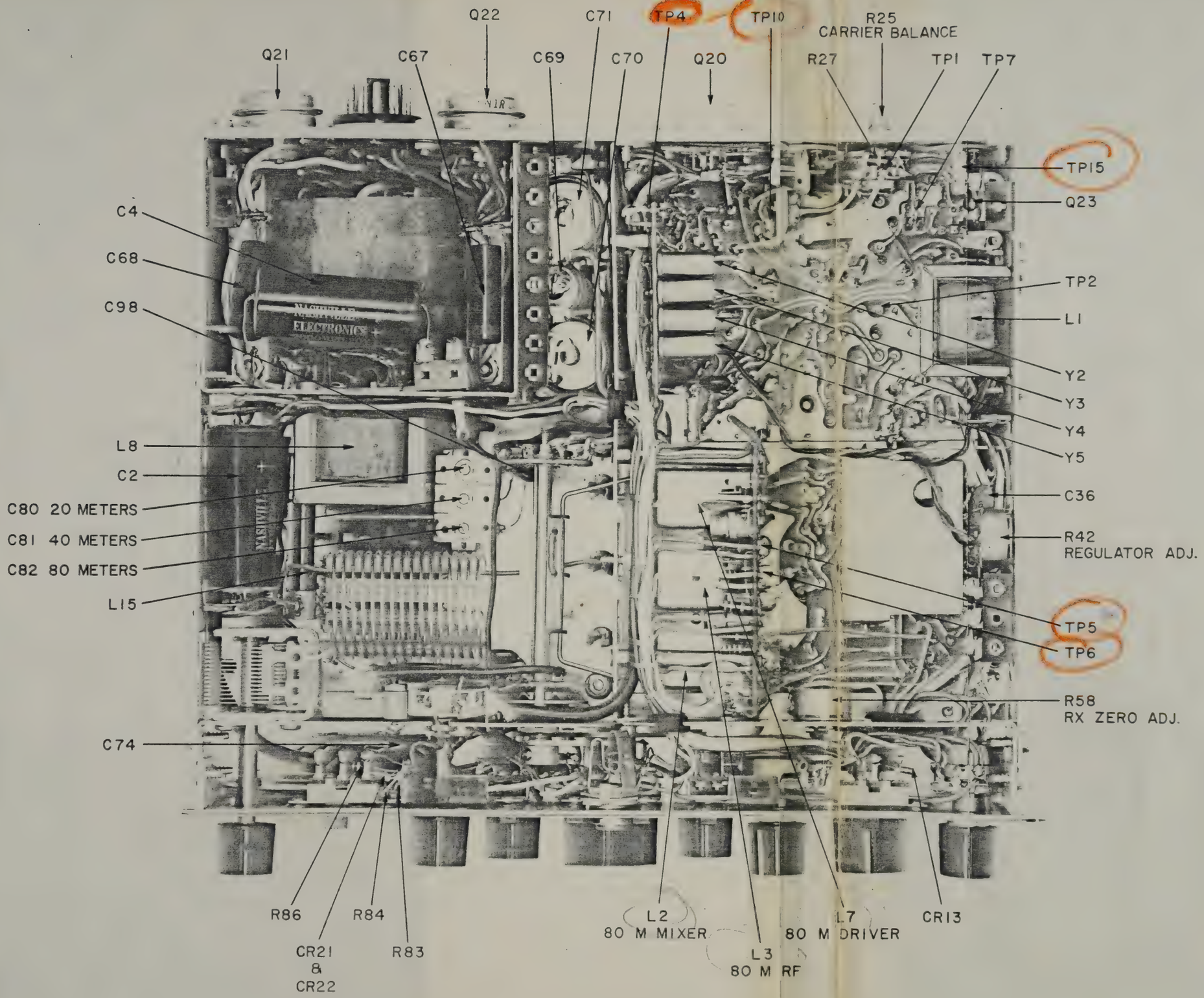
Symbol	Stock No.	Description
		CAPACITORS
C1,39,41,43, 95,99	235-7207P39	Ceramic, disc, .1mfd, 100V
C2,3	235-7215P43	Electrolytic, tubular, 2000mfd, 20V
C4	235-7353P84	Electrolytic, 1000mfd, 25V
C5,7,26,27,36, 42,45,46,50,56 57,60,61,62,63, 85,87,89,95,101	235-7195P12	Ceramic, disc, .01mfd, 500V
C6,10,15,16	235-7189P1	Electrolytic, tubular, 3mfd, 12V
C8	235-7215P1	Electrolytic, tubular, 3mfd, 12V
C9,12,37,94	235-7207P40	Ceramic, disc, .1mfd, 100V
C11	235-7188P15	Tantalum, 10mfd, 20V
C13,55	235-7207P8	Ceramic, disc, 100pfd, 600V
C14,20,51	235-7053P313	Mica, dipped, 390pfd, 500V
C17,29	235-7193P7	Mylar, dipped, .1mfd, 100V
C18,21	235-7189P20	Electrolytic, tubular, 250mfd, 12V
C19,25	235-7193P7	Mylar, dipped, 0.1mfd
C22	235-7207P6	Ceramic, disc, 56pfd, 600V
C23,32,33	235-7263P1	Variable, mica, compression
C24	235-7053P279	Mica, molded, 270pfd, 500V
C28	235-7207P14	Ceramic, disc, .001mfd, 600V
C30,34,97,98	235-7053P104	Mica, dipped, 150pfd, 500V
C31	235-7193P1	Mylar, dipped, 1000pfd, 100V
C35,40,91	235-7053P317	Mica, dipped, 560pfd, 500V
C38	235-7205P5	Mylar, dipped, .22mfd, 100V
C44	235-7196P61	Ceramic, disc, 15pfd, 500V
C47	235-7200P2	Bakelite, tubular, 1.0pfd, 500V
C48A,B,C	235-7185P1	Variable, 3-gang VFO
C49	235-7196P9	Ceramic, disc, 6.8pfd, 10%, NPO
C52	235-7053P56	Mica, dipped, 39pfd, 5%, 500V
C53	235-7053P44	Mica, dipped, 82pfd, 2%, 500V
C54	235-7260P1	Ceramic, variable, 5-12pfd
C58	235-7207P28	Ceramic, disc, .01mfd, 50V
C59,74	235-7207P14	Ceramic, disc, .001mfd, 500V
C64	235-7195P60	Ceramic, disc, .002mfd, 1KV
C65,79	235-7196P65	Ceramic, disc, 33pfd, NPO
C66	235-7200P4	Bakelite, tubular, 4.7pfd, 100V
C67,68	235-7215P22	Electrolytic, tubular, 50mfd, 50V
C69	235-7215P33	Electrolytic, tubular, 100mfd, 350V
C70	235-7215P35	Electrolytic, tubular, 100mfd, 350V
C71	235-7215P39	Electrolytic, tubular, 300mfd, 150V
C72,73	235-7215P3	Electrolytic, tubular, 4mfd, 150V
C75	235-7064P5	Mica, dipped, 1100pfd
C76	235-7267P1	Mica, variable, compression, PA load
C77	235-7210P20	Mica "HT" type, .0004mfd, 10%, 2500V
C78	235-7186P1	Variable, PA tune
C80-81-82	235-7274P1	Mica, variable, compression, 3-sec.

Symbol	Stock No.	Description
C83	235-7212P14	Paper, tubular, .1mfd, 600V
C84,96	235-7207P23	Ceramic, disc, .0047mfd, 3KV
C86	235-7259P1	Ceramic, neutralizing
C88	235-7053P0	Mica, dipped, 2pfd, 500V
C90,A,B,C	235-7184P1	Variable, 3-gang
C92	235-7200P6	Bakelite, tubular, 1.5pfd, 100V
C102	235-7193P27	Mylar, dipped, .1mfd, 100V
C103	235-7193P54	Mylar, dipped, .02mfd, 100V
C104	235-7193P57	Mylar, dipped, .1mfd, 100V
		DIODES
CR1,2,4,5,6, 7,8,21,22	322-7186P3	Germanium, S262
CR9	322-7186P6	Germanium, 1N87A
CR10	322-7175P5	Zener, 7.0V, 5mA
CR11	386-7178P1	Transistor 2N3565
CR12,13	322-7186P2	Germanium, 1N270
CR14,15	322-7154P2	Silicon, planar, HE9010
CR17,18,19,20	322-7180P1	Silicon, 1N2071
F1	226-1009P11	FUSE, 3amp, MDL
I-1	277-1015P1	LAMP, 28V, .17A bayonet
		SOCKETS
J-1	276-7195P1	Microphone
J2,4	282-7185P1	Vox & Calibrator, 7-pin min. tube
J3,5	276-7250P1	Antenna & Linear amp.
		COILS
L1	292-7200P1	Audio choke
L2	375-7223P1	Tune - (black dot)
L3	375-7223P2	Tune - (red dot)
L4	375-7260P1	VFO buffer
L5	375-7226P1	VFO
L6	375-7224P1	Crystal oscillator
L7	375-7223P3	Tune - (orange dot)
L8	292-7184P1	Filter
L9	375-7221P1	PA tank
L10	375-7183P1	23 mc trap
L11,12	375-7274P1	RF choke, 1mh
L13,14	375-7178P1	RF choke, 1mh
L15	375-7220P1	RF choke
M	245-7181P1	METER
P1	276-7269P1	PLUG, power
		TRANSISTORS
Q1	386-7224P1	2N2431
Q2,4,12,19	386-7184P1	2N3638

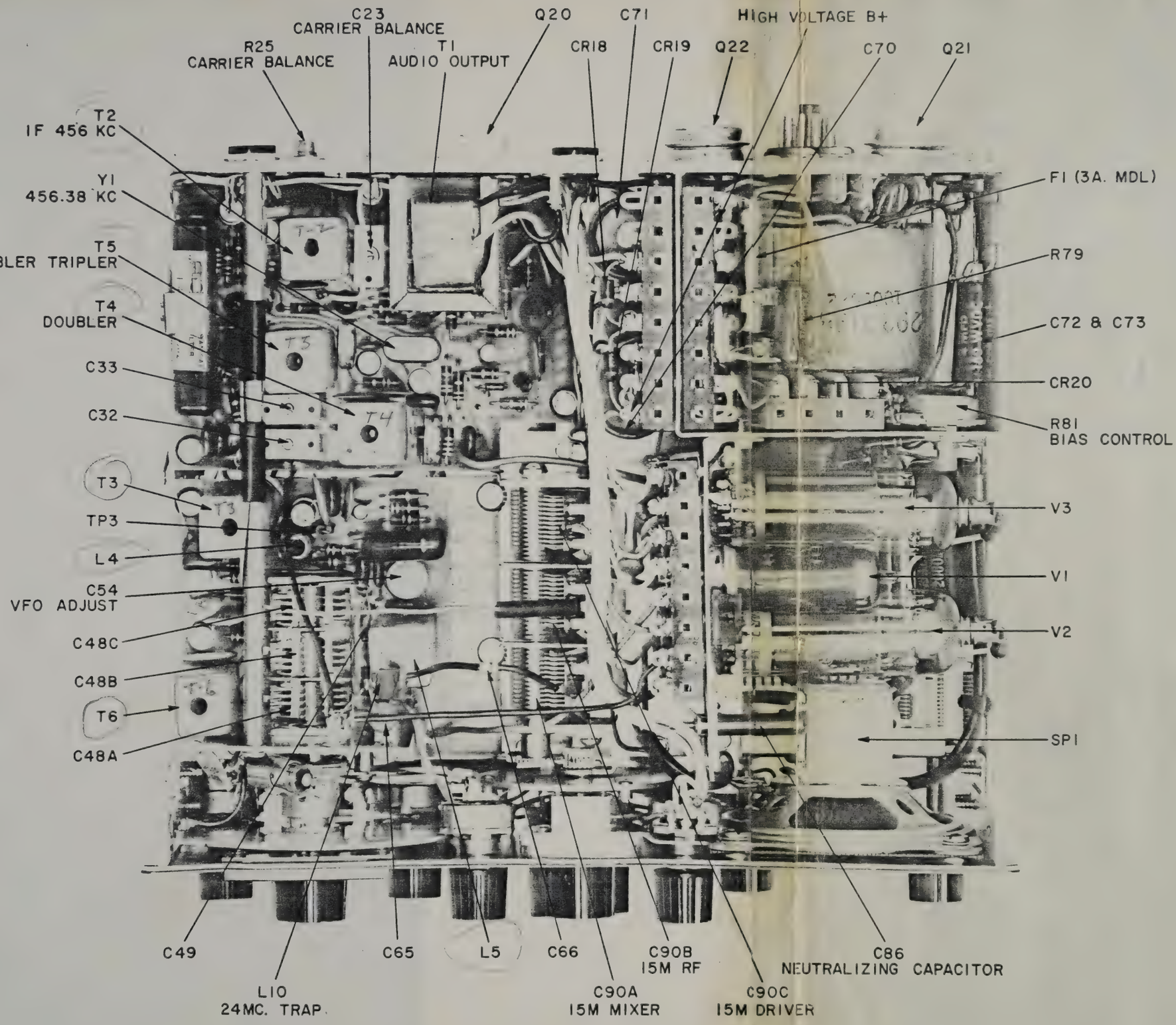
Other printed circ shows this as a 2N2672

Symbol	Stock No.	Description
Q3,16,17	386-7185P1	2N3642
Q5,6,7,8,9,11, 13,14	386-7219P1	2N2672
Q10	386-7223P1	2N2495
Q15	386-7188P1	2N3564
Q18,23	386-7177P1	2N3567 X1500N618
Q19	386-7184P1	2N3638
Q20	386-7200P1	2N2869/2N301 6822?
Q21,22	386-7205P3	2N443 or AE443 Red
		RESISTORS
		All fixed resistors are 10% carbon, 1/2 watt unless otherwise noted or schematic.
R1	240-7180P1	Microphone Gain Control, 10KΩ
R25	240-7178P1	Carrier balance, 200Ω
R41	240-7181P1	Volume Control, 5000Ω w/switch S5
R42	240-7196P1	Regulator adjust, WW, 50Ω, 2W
R58	240-7206P1	Receiver zero adjust, WW, 1KΩ, 2W
R59	240-7179P1	Pitch control, 1000Ω
R60	240-7179P1	Dial correct, 1000Ω
R79	280-1106P1	Fixed WW, 1Ω, 5W
R81	240-7221P1	Bias control, 10KΩ
		SWITCHES
S1	228-7280P1	Tune-Operate, DPDT slide
S2	228-7280P1	USB-LSB, DPDT slide
S3	228-7278P1	Pitch OFF-ON, SPDT slide, .5-amp, 125V
S4	228-7277P1	Calibrate, SPST slide, 1-amp. 125V Part of R41
S6	228-7279P1	Transmitter, SPST slide, 10-amp, 125V
S7,A,B,C	228-7194P1	Rotary Switch Assembly
S8	228-7280P1	Meter, DPDT slide
SP1	352-7177P1	SPEAKER, 3.2Ω
		TRANSFORMERS
T1	292-7199P1	Audio output
T2	375-7222P1	IF, 456Kc (red dot)
T3	375-7222P4	IF, 2281.9Kc
T4	375-7222P2	Doubler (green dot)
T5	375-7222P3	Doubler/Tripler (yellow dot)
T6	375-7222P5	IF, 3350Kc
T7	292-7198P1	Power

Symbol	Stock No.	Description
		TUBES
V1	290-7247P2	12DQ7
V2,3	290-7215P1	6GB5
		CRYSTALS
Y1	394-7189P1	456.38Kc
Y2	394-7185P1	7200Kc (80 meter)
Y3	394-7186P1	10475Kc (40 meter)
Y4	394-7187P1	17525Kc (20 meter)
Y5	394-7188P1	24635Kc (15 meter)
		MISCELLANEOUS
	7267-5005G1	Cabinet, complete w/handle
	7267-7012P1	Cable, DC, W-70
	7267-7013P1	Cable, AC, W-71
	7267-1065P1	Clamp, Mech. Filter
	7267-1045P1	Dial, Frequency
	7267-1027P1	Dial, Bezel
	7267-1028P1	Dial, Window
	7267-1047G1	Geneva Wheel assembly
	7251-1021G1	Geneva Plate assembly
	7267-1042P1	Grill, speaker
	231-7221G1	Handle, w/mounting clips
	231-7192P4	Knob, small round
	231-7196P2	Knob, large round, tuning
	231-7191P2	Knob, pointer, bandswitch
	369-7174P1	Mechanical Filter
	7267-1026P1	Panel, Front overlay
	7267-1035P1	Shaft, extension for C76
	7267-1063P1	Shield, top
	7267-1062P1	Shield, bottom
	7267-1064P1	Shield, VFO board
	386-7193P1	Socket, transistor, small
	386-7194P1	Socket, transistor, power
	282-7196P1	Socket, tube V-1
	282-7194P2	Socket, tube V-2-3
		Tuner Slug Assembly Parts
	297-7182P1	Ferrite slug (L-2-3-7)
	7251-1062P2	Slug connecting rod, nylon
	7267-1038P1	Yoke, wire
	7251-1024P1	Yoke Keeper, wire
	7251-1026P1	Yoke attachment bracket
	7267-1041P1	Vernier Drive, dual, ball
	7267-5016G2	I.F. Printed Circuit Board (less mechanical Filter)



CHASSIS BOTTOM VIEW



CHASSIS TOP VIEW

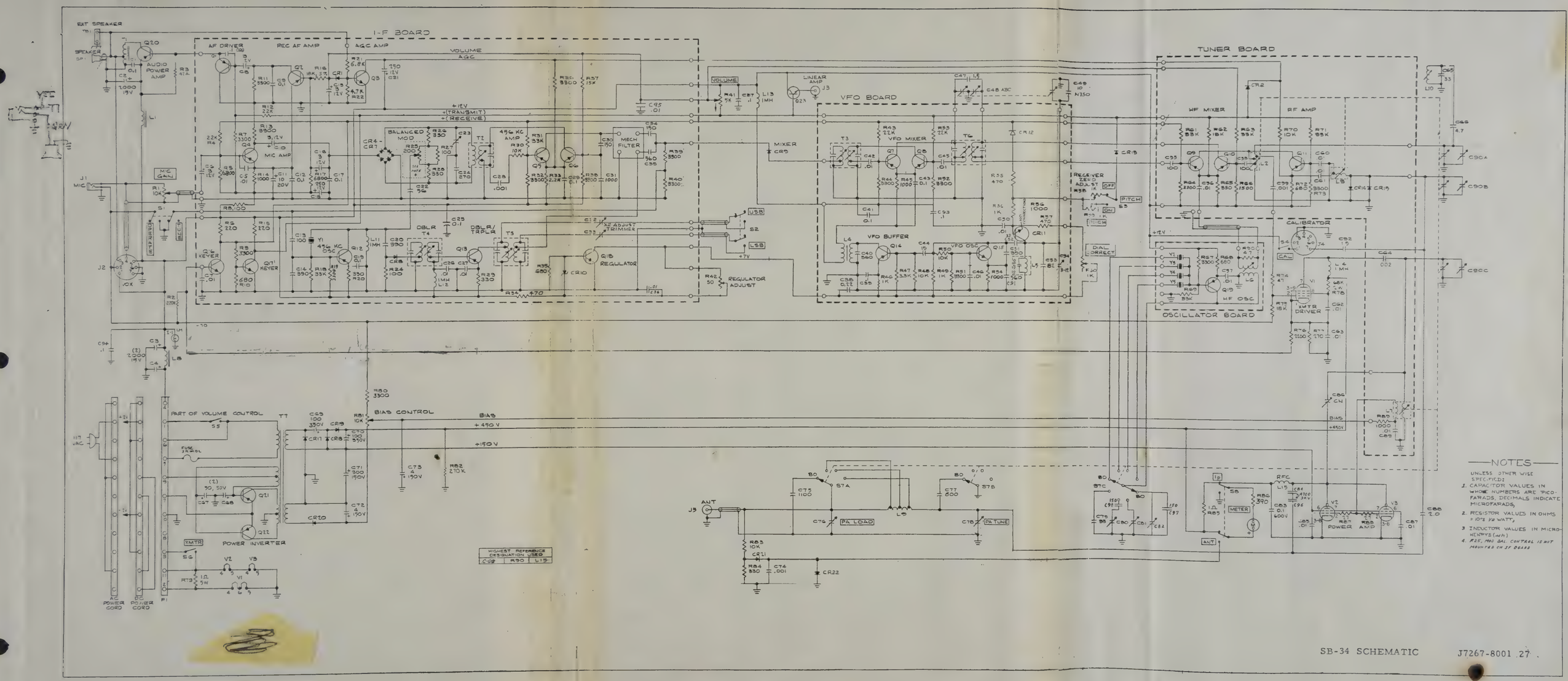
Symbol	Stock No.	Description
		CAPACITORS
C1, 39, 41, 43, 93, 99	235-7207P39	Ceramic, disc, .1mfd, 100V
C2,3,4	235-7215P43	Electrolytic, tubular, 2000mfd, 20V
C5,7,26,27,36, 42,45,46,50,56, 57,60,61,62,63, 85,87,89,95	235-7195P12	Ceramic, disc, .01mfd, 500V, GMV
C6,10,15,16	235-7189P1	Electrolytic, tubular, 3mfd, 12V
C8	235-7215P1	Electrolytic, tubular, 3mfd, 12V
C9,12,37,94	235-7207P40	Ceramic, disc, .1mfd, 100V
C11	235-7189P4	Electrolytic, 10mfd, 20V
C13,55,58	235-7207P8	Ceramic, disc, 100pfd, 600V
C14,20,51	235-7053P313	Mica, dipped, 390pfd, 500V
C17,29	235-7193P7	Mylar, dipped, .1mfd, 100V
C18,21	235-7189P20	Electrolytic, tubular, 250mfd, 12V
C19, 25	235-7193P7	Mylar, dipped, 0.1mfd
C22	235-7207P6	Ceramic, disc, 56pfd, 600V
C23, 32,	235-7263P1	Variable, mica, compression
C24	235-7053P279	Mica, molded, 270pfd, 500V
C28	235-7207P14	Ceramic, disc, .001mfd, 600V
C30,34,97,98	235-7053P104	Mica, dipped, 150pfd, 300V
C31	235-7193P1	Mylar, dipped, 1000pfd, 100V
C35,40,91	235-7053P317	Mica, dipped, 560pfd, 500V
C38	235-7205P5	Mylar, dipped, .22mfd, 100V
C44	235-7196P61	Ceramic, disc, 15pfd, 500V
C47, 92	235-7200P6	Bakelite, tubular, 1.5pfd, 100V
C48A,B,C	235-7185P1	Variable, 3-gang VFO
C49	235-7196P9	Ceramic, disc, 6.8pfd, 10%, NPO
C52	235-7053P36	Mica, dipped, 33pfd, 5%, 300V
C53	235-7053P44	Mica, dipped, 82pfd, 2%, 500V
C54	235-7260P1	Ceramic, variable, 3-12pfd
C59,74	235-7207P14	Ceramic, disc, .001mfd, 500V
C64	235-7195P60	Ceramic, disc, .002mfd, 1KV
C65,79	235-7196P63	Ceramic, disc, 33pfd, NPO
C66	235-7200P4	Bakelite, tubular, 4.7pfd, 100V
C67,68	235-7215P22	Electrolytic, tubular, 50mfd, 50V
C69	235-7215P33	Electrolytic, tubular, 100mfd, 350V
C70	235-7215P33	Electrolytic, tubular, 100mfd, 350V
C71	235-7215P39	Electrolytic, tubular, 300mfd, 150V
C72,73	235-7215P3	Electrolytic, tubular, 4mfd, 150V
C75	235-7064P5	Mica, dipped, 1100pfd
C76	235-7267P1	Mica, variable, compression, PA load
C77	235-7210P7	Mica, "H" type, .0005 mfd, 10%, 2500V
C78	235-7186P1	Variable, PA tune
C80-81-82	235-7274P1	Mica, variable, compression, 3-sec.

Symbol	Stock No.	Description
C83	235-7212P14	Paper, tubular, .1mfd, 600V
C84, 96	235-7207P25	Ceramic, disc, .0047mfd, 3KV
C86	235-7259P1	Ceramic, neutralizing
C88	235-7053P0	Mica, dipped, 2pfd, 500V
C90, A, B, C,	235-7184P1	Variable, 3-gang
		DIODES
CR1,2,4,5,6, 7,8,21,22	322-7186P3	Germanium, S262
CR9	322-7186P6	Germanium, 1N87A
CR10	322-7175P5	Zener, 7.0V, 5mA
CR11	386-7178P2	Transistor 2N3565
CR12,13	322-7186P2	Germanium 1N270
CR14,15	322-7184P2	Silicon, planar, HE9010
CR17,18,19,20	322-7180P1	Silicon, 1N2071
F1	226-1009P1.1	FUSE, 3amp, MDL
I-1	277-1013P1	LAMP, 28V, .17A bayonet
		SOCKETS
J-1	276-7195P1	Microphone
J2, 4	282-7185P	Vox & Calibrator, 7-pin min. tube
J3, 5	276-7250P1	Antenna & Linear amp.
		COILS
L1	292-7200P1	Audio choke
L2	375-7223P1	Tuner (black dot)
L3	375-7223P2	Tuner (red dot)
L4	375-7260P1	VFO buffer
L5	375-7226P1	VFO
L6	375-7224P1	Crystal oscillator
L7	375-7223P3	Tuner (orange dot)
L8	292-7184P1	Filter
L9	375-7221P1	PA tank
L10	375-7183P1	23 mc trap
L11, 12	375-7274P1	RF choke, 1mh
L13, 14	375-7178P1	RF choke, 1mh
L15	375-7220P1	RF choke
M	245-7181P1	METER
P1	276-7269P1	PLUG, power
		TRANSISTORS
Q1	386-7224P1	2N2431
Q2, 4, 19	386-7184P1	2N3638
Q3, 16, 17	386-7185P1	2N3642

in 2N3638 on written sheet

Symbol	Stock No.	Description
Q5,6,7,8,9,11, 12,13,14	386-7219P1	2N2672
Q10	386-7223P1	2N2495
Q15	386-7188P1	2N3564
Q18, 23	386-7214P1	2N2926 in 2N3567 white shield
Q19,	386-7184P1	2N3638
Q20	386-7200P1	2N2869/2N301
Q21,22	386-7205P3	2N443 or AE443 Red
		RESISTORS
		All fixed resistors are 10% carbon, 1/2 watt unless otherwise noted on schematic.
R1	240-7180P1	Microphone Gain Control, 10KΩ
R25	240-7178P1	Carrier balance, 200Ω
R41	240-7181P1	Volume Control, 5000Ω w/switch S5
R42	240-7196P1	Regulator adjust, WW, 500Ω, 2W
R58	240-7206P1	Receiver zero adjust, WW, 1KΩ, 2W
R59	240-7179P1	Pitch control, 1000Ω
R60	240-7179P1	Dial correct, 1000Ω
R79	280-1106P1	Fixed WW, 1Ω, 5W
R81	240-7221P1	Bias control, 10KΩ
		SWITCHES
S1	228-7280P1	Tune-Operate, DPDT slide
S2	228-7280P1	USB-LSB, DPDT slide
S3	228-7278P1	Pitch OFF-ON, SPDT slide, .5-amp, 125V
S4	228-7277P1	Calibrate, SPST slide, -amp, 125V
S5		Part of R41
S6	228-7279P1	Transmitter, SPST slide 10-amp, 125V
S7, A, B, C	228-7194P1	Rotary Switch Assembly
S8	228-7280P1	Meter, DPDT slide
SP1	352-7177P1	SPEAKER, 3.2Ω
		TRANSFORMERS
T1	292-7199P1	Audio output
T2	375-7222P1	IF, 456Kc (red dot)
T3	375-7222P4	IF, 2281.9Kc
T4	375-7222P2	Doubler (green dot)
T5	375-7222P3	Doubler/Tripler (yellow dot)
T6	375-7222P5	IF, 3350Kc
T7	292-7198P1	Power

Symbol	Stock No.	Description
		TUBES
V1	290-7247P2	12DQ7
V2, 3	290-7215P1	6GB5
		CRYSTALS
Y1	394-7189P1	456.38Kc
Y2	394-7185P1	7200Kc (80 meter)
Y3	394-7186P1	10475Kc (40 meter)
Y4	394-7187P1	17525Kc (20 meter)
Y5	394-7188P1	24625Kc (15 meter)
		MISCELLANEOUS
	7267-5005G1	Cabinet, complete w/handle
	7267-7012P1	Cable, DC, W-70
	7267-7013P1	Cable, AC, W-71
	7267-1065P1	Clamp, Mech. Filter
	7267-1045P1	Dial, Frequency
	7267-1027P1	Dial, Bezel
	7267-1028P1	Dial, Window
	7267-1047G1	Geneva Wheel assembly
	7251-1021G1	Geneva Plate assembly
	7267-1042P1	Grill, speaker
	231-7221G1	Handle, w/mounting clips
	231-7192P4	Knob, small round
	231-7196P2	Knob, large round, tuning
	231-7191P2	Knob, pointer, bandswitch
	369-7174P1	Mechanical Filter
	7267-1026P1	Panel, Front overlay
	7267-1035P1	Shaft, extension for C76
	7267-1063P1	Shield, top
	7267-1062P1	Shield, bottom
	7267-1064P1	Shield, VFO board
	386-7193P1	Socket, transistor, small
	386-7194P1	Socket, transistor, power
	282-7196P1	Socket, tube V-1
	282-7194P2	Socket, tube V-2-3
		Tuner Slug Assembly Parts
	297-7182P1	Ferrite slug (L-2-3-7)
	7251-1062P2	Slug connecting rod, nylon
	7267-1038P1	Yoke, wire
	7251-1024P1	Yoke Keeper, wire
	7251-1026P1	Yoke attachment bracket
	7267-1041P1	Vernier Drive, dual, ball
	7267-5016G2	I.F. Printed Circuit Board (less mechanical Filter)



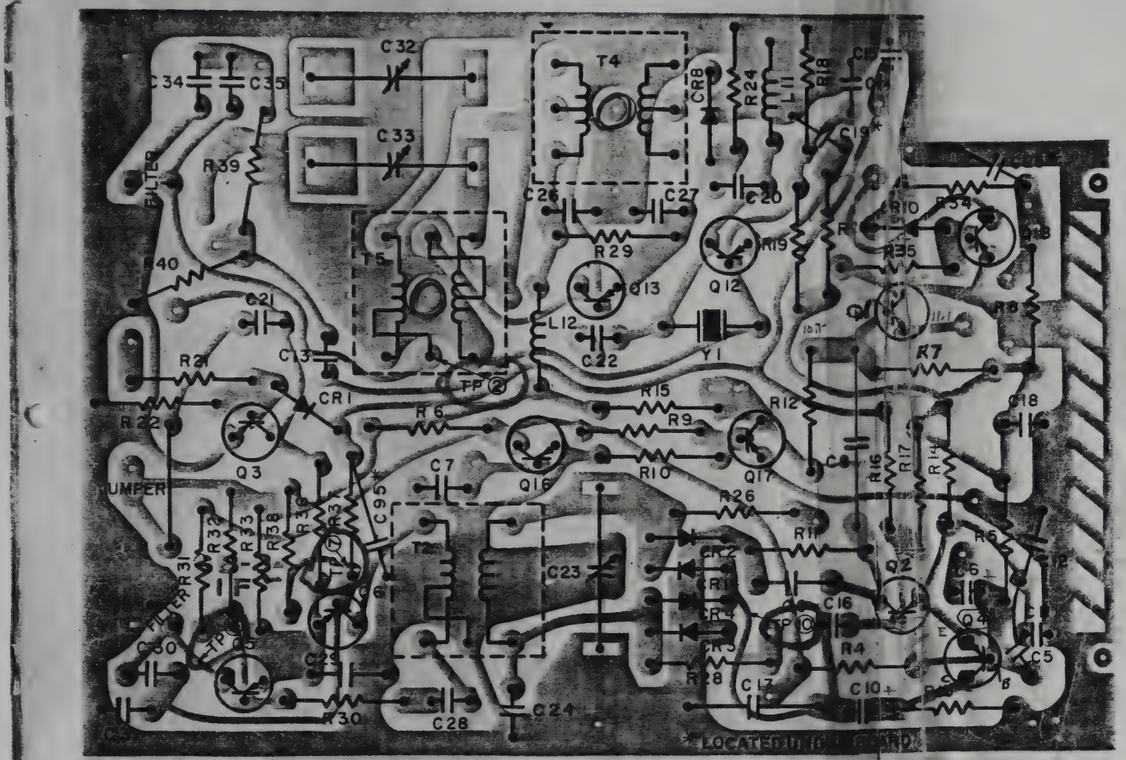
NOTES

UNLESS OTHER WISE SPECIFIED:

1. CAPACITOR VALUES IN WHOLE NUMBERS ARE PICOFARADS, DECIMALS INDICATE MICROFARADS.
2. RESISTOR VALUES IN OHMS ± 10% 1/2 WATT.
3. INDUCTOR VALUES IN MICROHENRYS (uH)
4. R35, R90 BAL CONTROL IS NOT MOUNTED ON IF BOARD

SB-34 SCHEMATIC J7267-8001 27

VFO BOARD BOTTOM


C32
C34
C35
C33
R39
FILTER
T4
CR8
R24
L11
R18
C19*
C26
C27
C20
R29
Q13
Q12
R19
R10
R34
R35
L12
C22
Y1
R7
R8
C21
C13
R2
R22
CR1
TP2
R15
R9
R12
R6
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C7
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R17
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R26
R11
C23
CR2
CR1
CR4
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C10
R28
C17
C30
TP9
R30
C28
C24
R5
C12
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R33
R38
R37
C25
C29
C31
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Q7
Q8
Q9
Q10
Q11
R20
R21
R23
R25
R40
R41
R42
R43
R44
R45
R46
R47
R48
R49
R50
R51
R52
R53
R54
R55
R56
R57
R58
R59
R60
R61
R62
R63
R64
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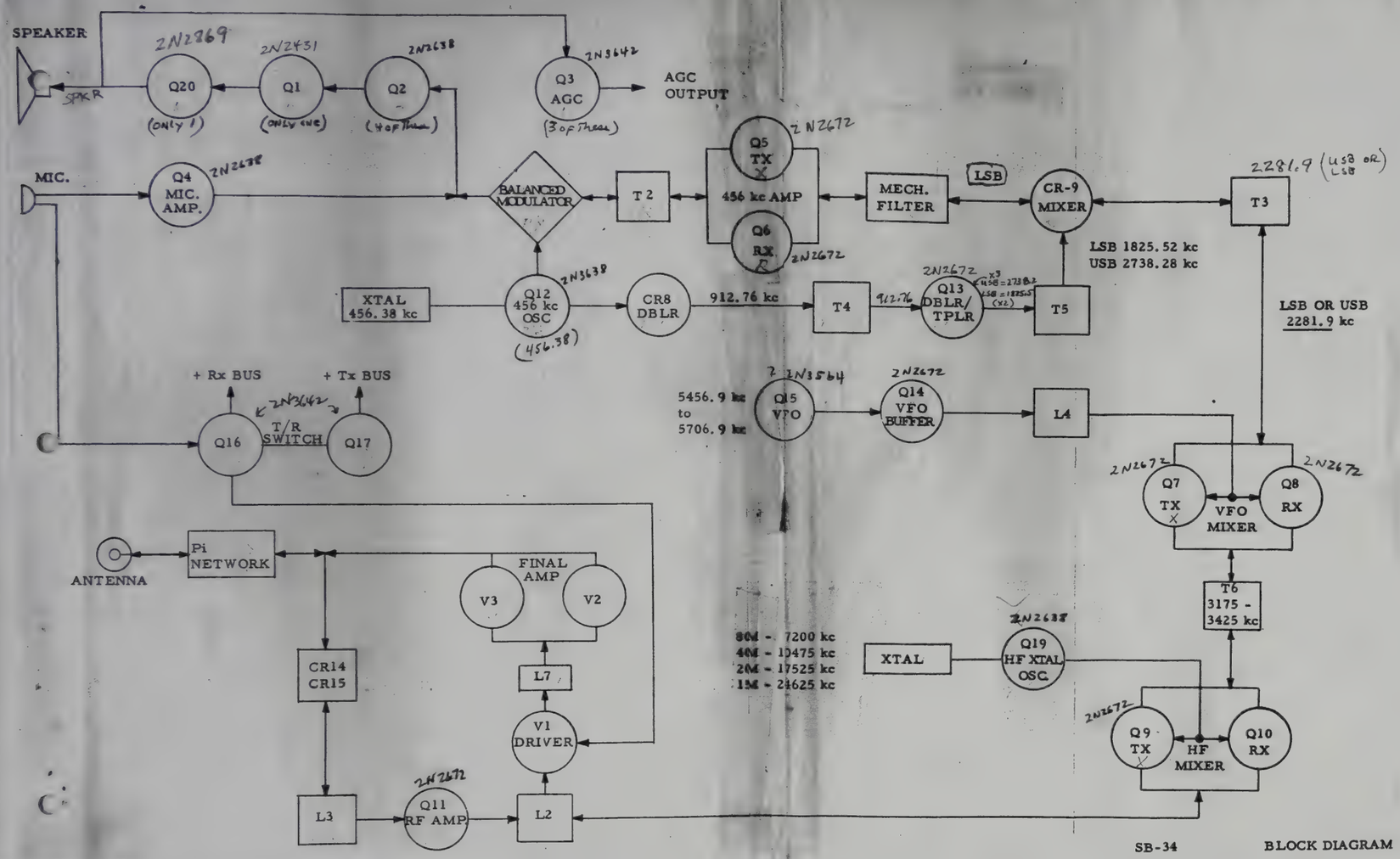
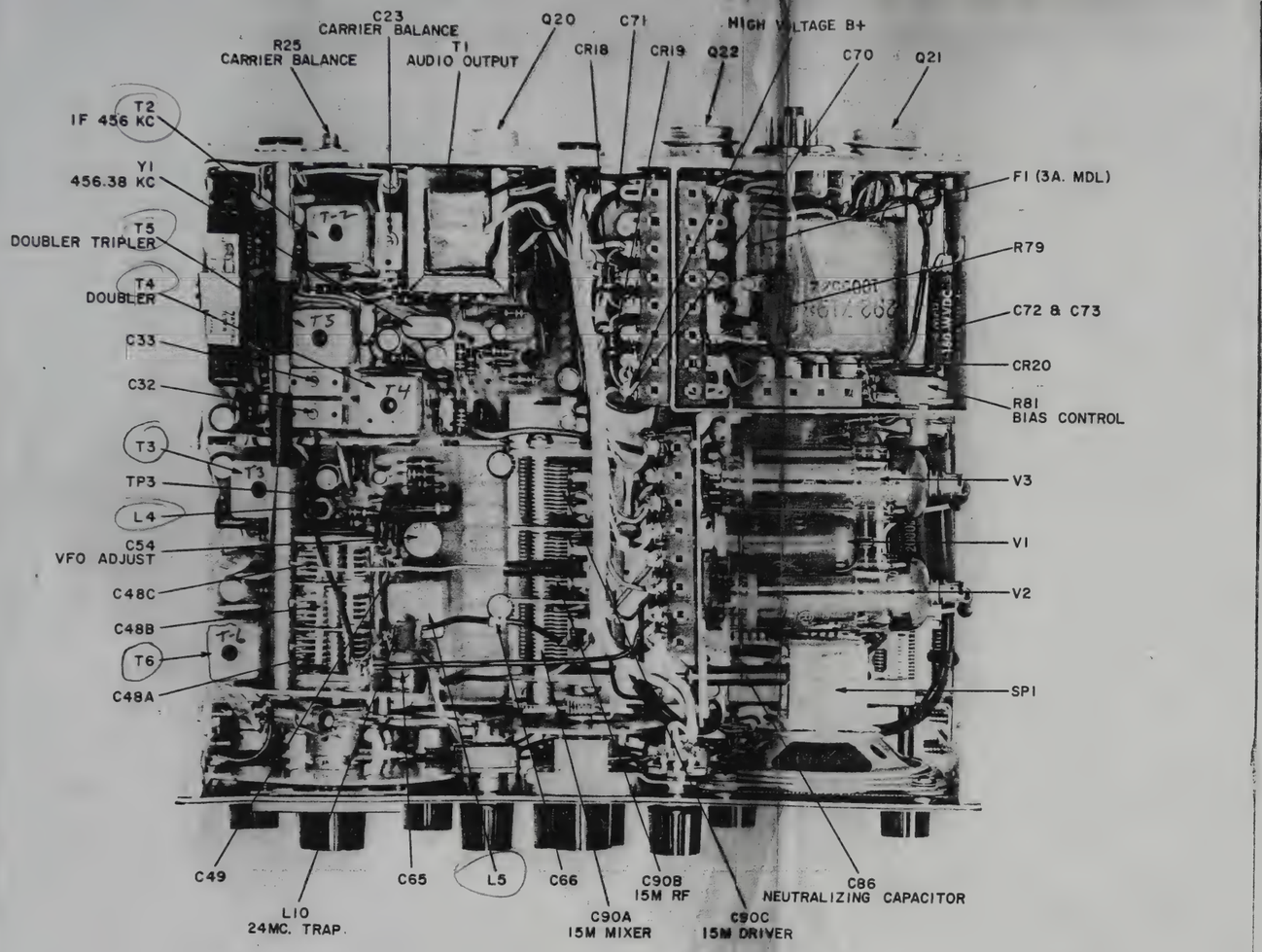
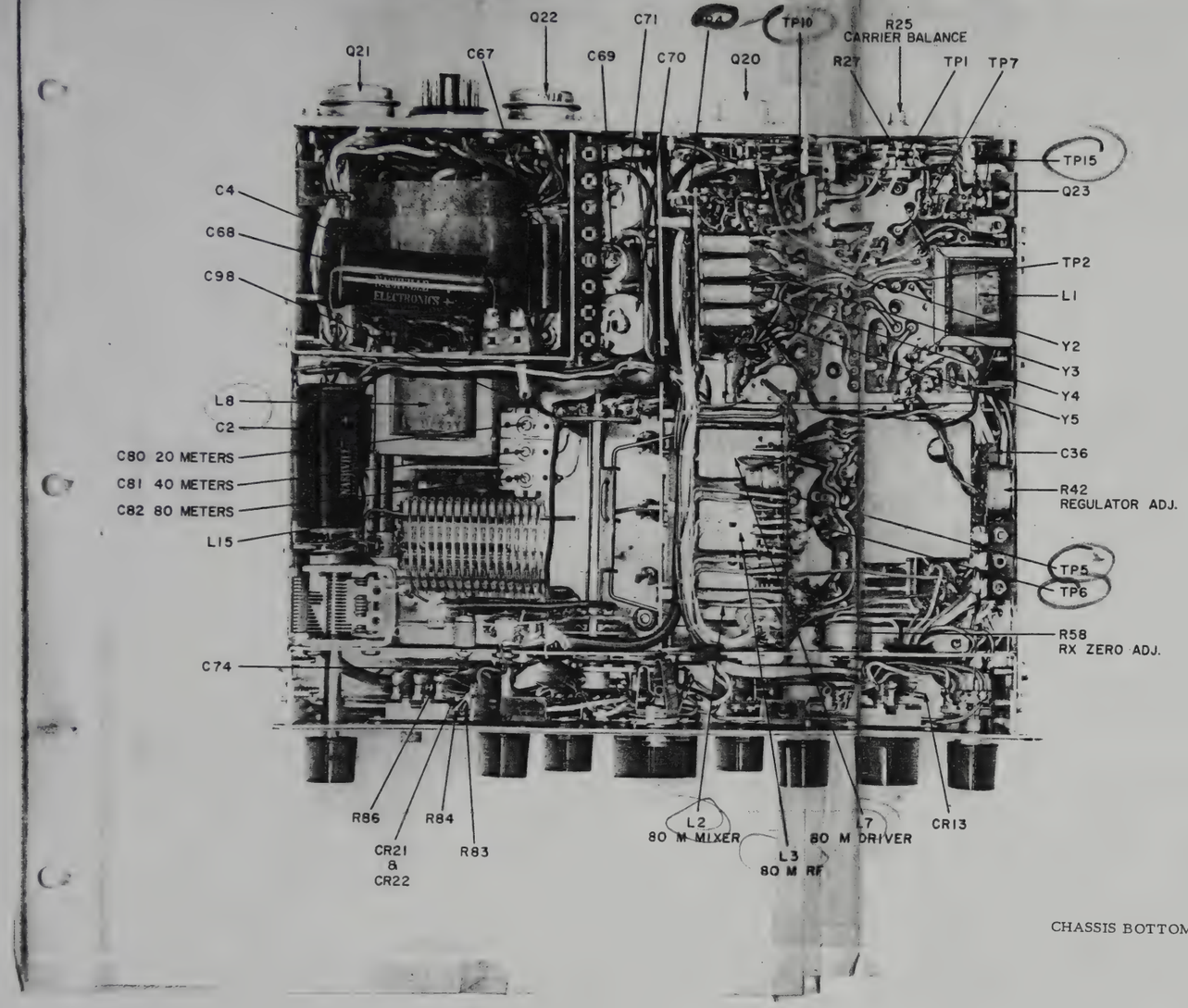
R71
R72
R73
R74
R75
R76
R77
R78
R79



SB-34 BLOCK DIAGRAM



CHASSIS TOP VIEW



CHASSIS BOTTOM VIEW

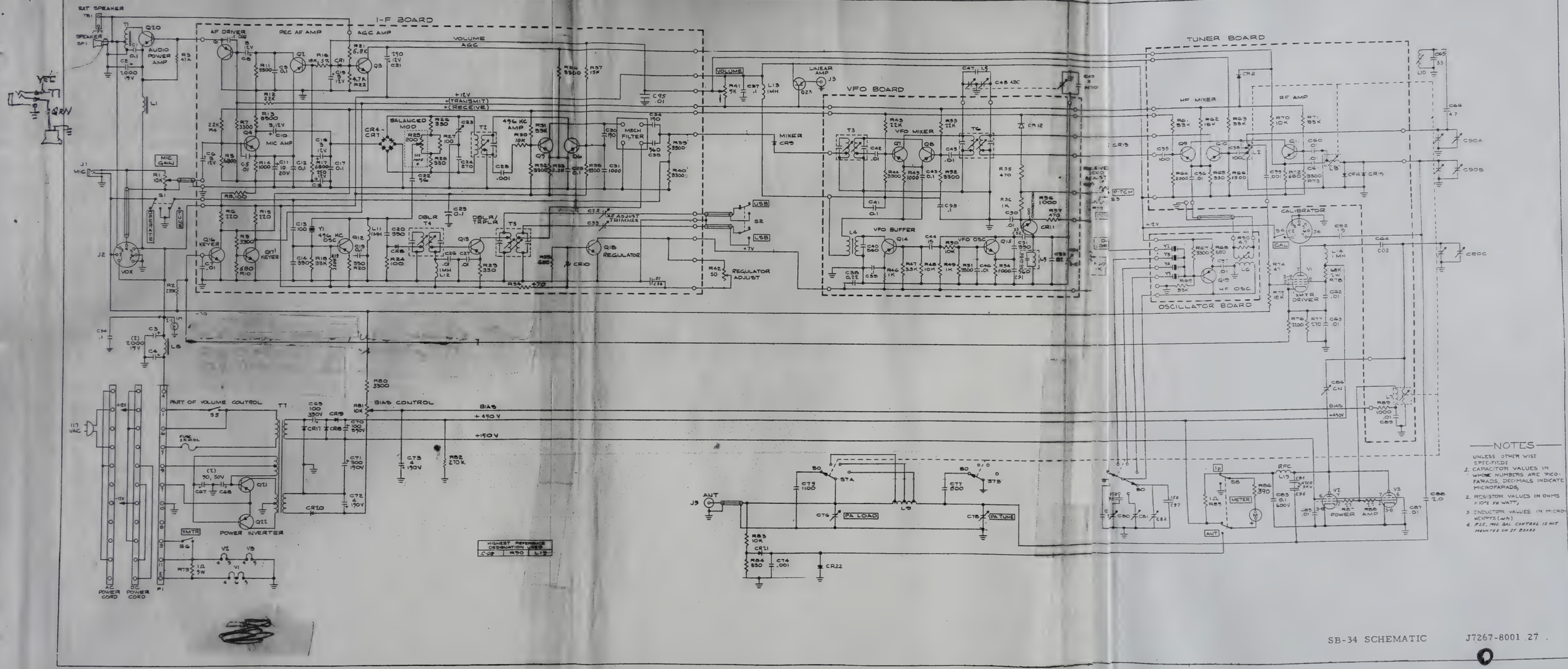
Symbol	Stock No.	Description
		CAPACITORS
C1,39,41,43, 93,99	235-7207P39	Ceramic, disc, .1mfd, 100V
C2,3	235-7215P43	Electrolytic, tubular, 2000mfd, 20V
C4	235-7353P84	Electrolytic, 1000mfd, 25V
C5,7,26,27,36, 42,45,46,50,56, 57,60,61,62,63, 85,87,89,95,101	235-7195P12	Ceramic, disc, .01mfd, 500V
C6,10,15,16	235-7189P1	Electrolytic, tubular, 3mfd, 12V
C8	235-7215P1	Electrolytic, tubular, 3mfd, 12V
C9,12,37,94	235-7207P40	Ceramic, disc, .1mfd, 100V
C11	235-7188P15	Tantalum, 10mfd, 20V
C13,55	235-7207P8	Ceramic, disc, 100pfd, 600V
C14,20,51	235-7053P313	Mica, dipped, 390pfd, 500V
C17,29	235-7193P7	Mylar, dipped, .1mfd, 100V
C18,21	235-7189P20	Electrolytic, tubular, 250mfd, 12V
C19,25	235-7193P7	Mylar, dipped, 0.1mfd
C22	235-7207P6	Ceramic, disc, 56pfd, 600V
C23,32,33	235-7263P1	Variable, mica, compression
C24	235-7053P279	Mica, molded, 270pfd, 500V
C28	235-7207P14	Ceramic, disc, .001mfd, 600V
C30,34,97,98	235-7053P104	Mica, dipped, 150pfd, 300V
C31	235-7193P1	Mylar, dipped, 1000pfd, 100V
C35,40,91	235-7053P317	Mica, dipped, 560pfd, 500V
C38	235-7205P5	Mylar, dipped, .22mfd, 100V
C44	235-7196P61	Ceramic, disc, 15pfd, 500V
C47	235-7200P2	Bakelite, tubular, 1.0pfd, 500V
C48A,B,C	235-7185P1	Variable, 3-gang VFO
C49	235-7196P9	Ceramic, disc, 6.8pfd, 10%, NPO
C52	235-7053P36	Mica, dipped, 33pfd, 5%, 300V
C53	235-7053P44	Mica, dipped, 82pfd, 2%, 500V
C54	235-7260P1	Ceramic, variable, 3-12pfd
C58	235-7207P28	Ceramic, disc, .01mfd, 50V
C59,74	235-7207P14	Ceramic, disc, .001mfd, 500V
C64	235-7195P60	Ceramic, disc, .002mfd, 1KV
C65,79	235-7196P63	Ceramic, disc, 33pfd, NPO
C66	235-7200P4	Bakelite, tubular, 4.7pfd, 100V
C67,68	235-7215P22	Electrolytic, tubular, 50mfd, 50V
C69	235-7215P33	Electrolytic, tubular, 100mfd, 350V
C70	235-7215P33	Electrolytic, tubular, 100mfd, 350V
C71	235-7215P39	Electrolytic, tubular, 300mfd, 150V
C72,73	235-7215P3	Electrolytic, tubular, 4mfd, 150V
C75	235-7064P5	Mica, dipped, 1100pfd
C76	235-7267P1	Mica, variable, compression, PA load
C77	235-7210P20	Mica "H" type, .0004mfd, 10%, 2500V
C78	235-7186P1	Variable, PA tune
C80-81-82	235-7274P1	Mica, variable, compression, 3-sec.

Symbol	Stock No.	Description
C83	235-7212P14	Paper, tubular, .1mfd, 600V
C84,96	235-7207P25	Ceramic, disc, .0047mfd, 3KV
C86	235-7259P1	Ceramic, neutralizing
C88	235-7053P9	Mica, dipped, 2pfd, 500V
C90,A,B,C	235-7184P1	Variable, 3-gang
C92	235-7200P6	Bakelite, tubular, 1.5pfd, 100V
C102	235-7193P57	Mylar, dipped, .1mfd, 100V
C103	235-7193P54	Mylar, dipped, .02mfd, 100V
C104	235-7193P57	Mylar, dipped, .1mfd, 100V
		DIODES
CR1,2,4,5,6, 7,8,21,22	322-7186P3	Germanium, S262
CR9	322-7186P6	Germanium, 1N87A
CR10	322-7175P5	Zener, 7.0V, 5mA
CR11	386-7178P1	Transistor 2N3565
CR12,13	322-7186P2	Germanium, 1N270
CR14,15	322-7184P2	Silicon, planar, HE9010
CR17,18,19,20	322-7180P1	Silicon, 1N2071
F1	226-1009P11	FUSE, 3amp, MDL
I-1	277-1013P1	LAMP, 28V, .17A bayonet
		SOCKETS
J-1	276-7195P1	Microphone
J2,4	282-7185P1	Vox & Calibrator, 7-pin min. tube
J3,5	276-7250P1	Antenna & Linear amp.
		COILS
L1	292-7200P1	Audio choke
L2	375-7223P1	Tuner (black dot)
L3	375-7223P2	Tuner (red dot)
L4	375-7260P1	VFO buffer
L5	375-7226P1	VFO
L6	375-7224P1	Crystal oscillator
L7	375-7223P3	Tuner (orange dot)
L8	292-7184P1	Filter
L9	375-7221P1	PA tank
L10	375-7183P1	23 mc trap
L11,12	375-7274P1	RF choke, 1mh
L13,14	375-7178P1	RF choke, 1mh
L15	375-7220P1	RF choke
M	245-7181P1	METER
P1	276-7269P1	PLUG, power
		TRANSISTORS
Q1	386-7224P1	2N2431
Q2,4,12,19	386-7184P1	2N3638

Other printed list shows this as a 2N2672

Symbol	Stock No.	Description
Q3,16,17	386-7185P1	2N3642
Q5,6,7,8,9,11, 13,14	386-7219P1	2N2672
Q10	386-7223P1	2N2495
Q15	386-7188P1	2N3564
Q18,23	386-7177P1	2N3567 YES ON 618
Q19	386-7184P1	2N3638
Q20	386-7200P1	2N2869/2N301 6822?
Q21,22	386-7205P3	2N443 or AE443 Red
		RESISTORS
		All fixed resistors are 10% carbon, 1/2 watt unless otherwise noted on schematic.
R1	240-7180P1	Microphone Gain Control, 10KΩ
R25	240-7178P1	Carrier balance, 200Ω
R41	240-7181P1	Volume Control, 5000Ω w/switch S5
R42	240-7196P1	Regulator adjust, WW, 50Ω, 2W
R58	240-7206P1	Receiver zero adjust, WW, 1KΩ, 2W
R59	240-7179P1	Pitch control, 1000Ω
R60	240-7179P1	Dial correct, 1000Ω
R79	280-1106P1	Fixed WW, 1Ω, 5W
R81	240-7221P1	Bias control, 10KΩ
		SWITCHES
S1	228-7280P1	Tune-Operate, DPDT slide
S2	228-7280P1	USB-LSB, DPDT slide
S3	228-7278P1	Pitch OFF-ON, SPDT slide, .5-amp, 125V
S4	228-7277P1	Calibrate, SPST slide, 1-amp, 125V Part of R41
S6	228-7279P1	Transmitter, SPST slide, 10-amp, 125V
S7,A,B,C	228-7194P1	Rotary Switch Assembly
S8	228-7280P1	Meter, DPDT slide
SP1	352-7177P1	SPEAKER, 3.2Ω
		TRANSFORMERS
T1	292-7199P1	Audio output
T2	375-7222P1	IF, 456Kc (red dot)
T3	375-7222P4	IF, 2281.9Kc
T4	375-7222P2	Doubler (green dot)
T5	375-7222P3	Doubler/Tripler (yellow dot)
T6	375-7222P5	IF, 3350Kc
T7	292-7198P1	Power

Symbol	Stock No.	Description
		TUBES
V1	290-7247P2	12DQ7
V2,3	290-7215P1	6GB5
		CRYSTALS
Y1	394-7189P1	456.38Kc
Y2	394-7185P1	7200Kc (80 meter)
Y3	394-7186P1	10475Kc (40 meter)
Y4	394-7187P1	17525Kc (20 meter)
Y5	394-7188P1	24625Kc (15 meter)
		MISCELLANEOUS
	7267-5005G1	Cabinet, complete w/handle
	7267-7012P1	Cable, DC, W-70
	7267-7013P1	Cable, AC, W-71
	7267-1065P1	Clamp, Mech. Filter
	7267-1045P1	Dial, Frequency
	7267-1027P1	Dial, Bezel
	7267-1028P1	Dial, Window
	7267-1047G1	Geneva Wheel assembly
	7251-1021G1	Geneva Plate assembly
	7267-1042P1	Grill, speaker
	231-7221G1	Handle, w/mounting clips
	231-7192P4	Knob, small round
	231-7196P2	Knob, large round, tuning
	231-7191P2	Knob, pointer, bandswitch
	369-7174P1	Mechanical Filter
	7267-1026P1	Panel, Front overlay
	7267-1035P1	Shaft, extension for C76
	7267-1063P1	Shield, top
	7267-1062P1	Shield, bottom
	7267-1064P1	Shield, VFO board
	386-7193P1	Socket, transistor, small
	386-7194P1	Socket, transistor, power
	282-7196P1	Socket, tube V-1
	282-7194P2	Socket, tube V-2-3
		Tuner Slug Assembly Parts
	297-7182P1	Ferrite slug (L-2-3-7)
	7251-1062P2	Slug connecting rod, nylon
	7267-1038P1	Yoke, wire
	7251-1024P1	Yoke Keeper, wire
	7251-1026P1	Yoke attachment bracket
	7267-1041P1	Vernier Drive, dual, ball
	7267-5016G2	I.F. Printed Circuit Board (less mechanical Filter)

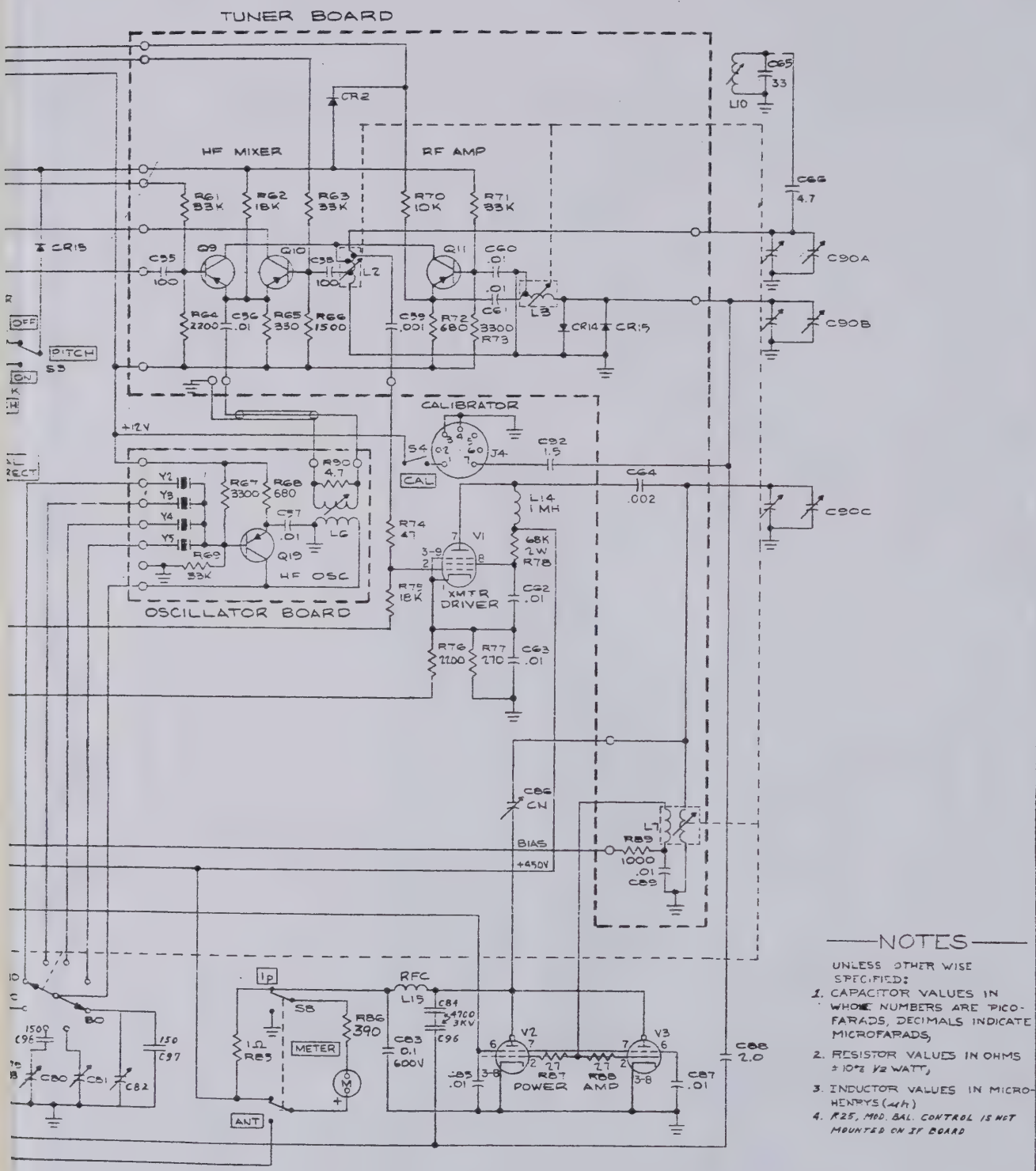


NOTES

UNLESS OTHER WISE SPECIFIED:

1. CAPACITOR VALUES IN WHOLE NUMBERS ARE MICROFARADS, DECIMALS INDICATE MICROFARADS.
2. RESISTOR VALUES IN OHMS ± 10% ½ WATT.
3. INDUCTOR VALUES IN MICRO HENRYS (μh)
4. P25, 450 BAL CONTROL IS NOT MOUNTED ON IF BOARD

SB-34 SCHEMATIC J7267-8001 27

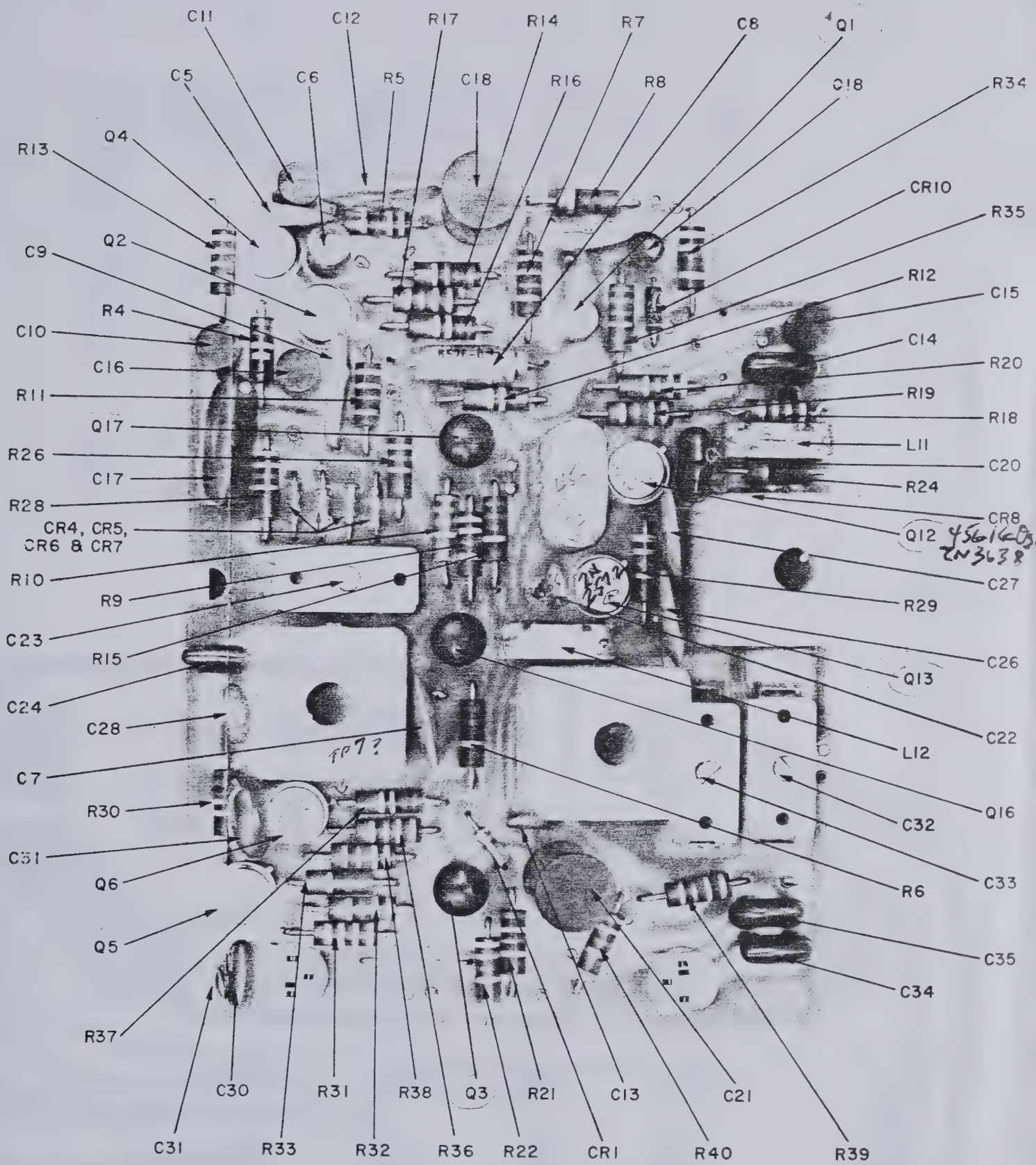


NOTES

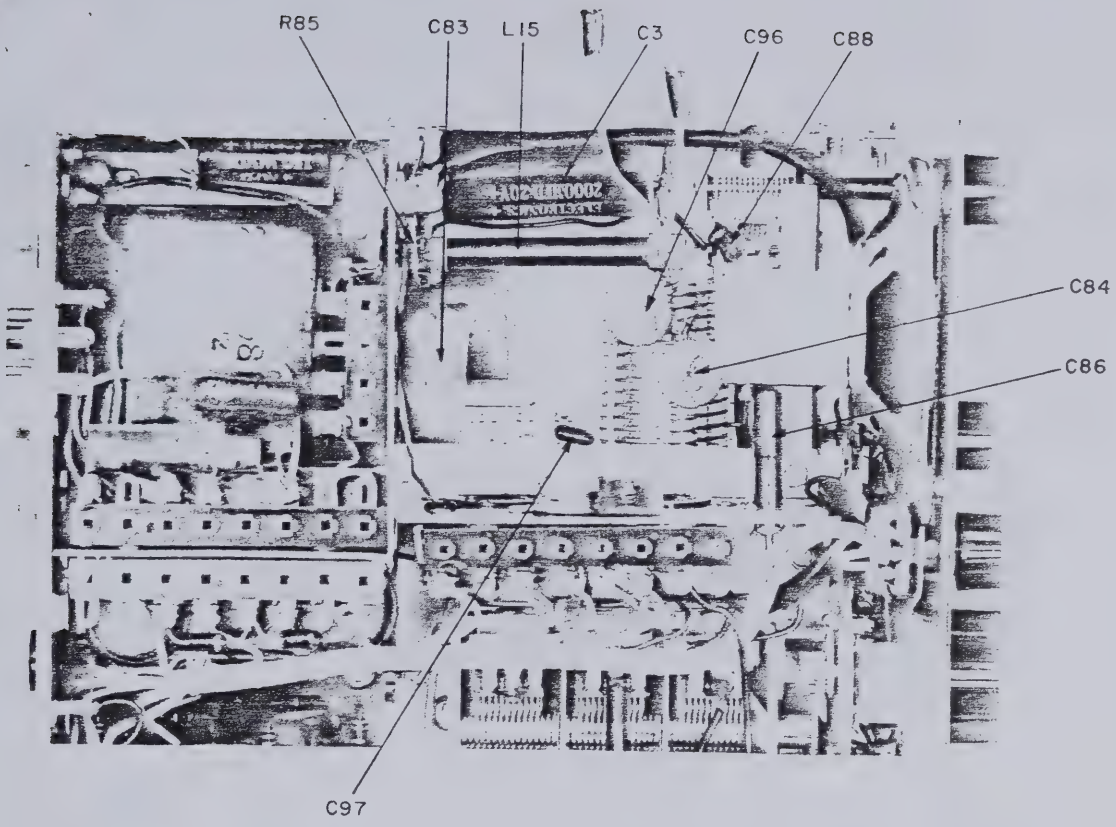
UNLESS OTHER WISE SPECIFIED:

1. CAPACITOR VALUES IN WHOLE NUMBERS ARE PICOFARADS, DECIMALS INDICATE MICROFARADS,
2. RESISTOR VALUES IN OHMS ±10% ½ WATT,
3. INDUCTOR VALUES IN MICROHENRYS (μh)
4. R25, MOD. BAL. CONTROL IS NOT MOUNTED ON IF BOARD

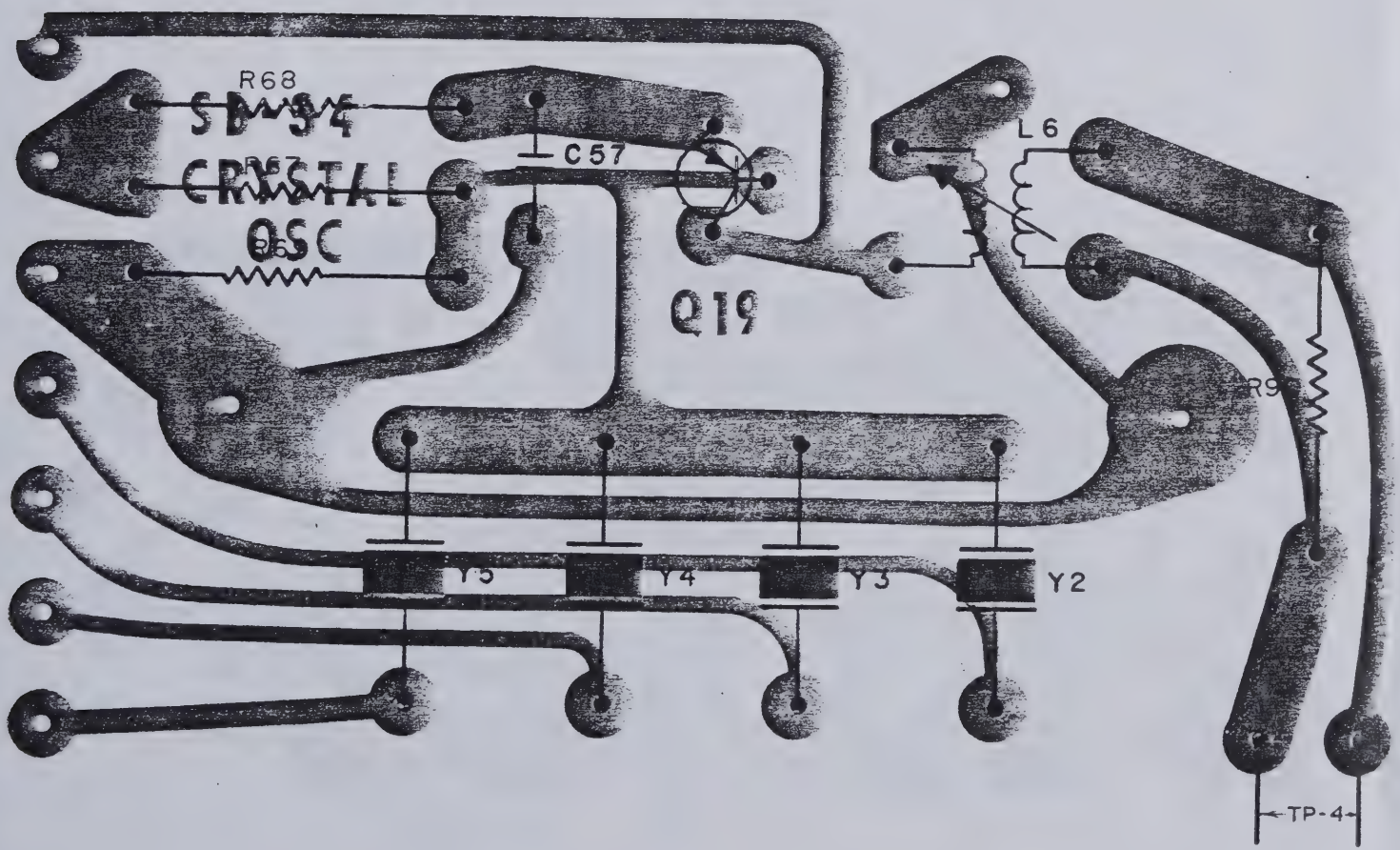
SB-34 SCHEMATIC J7267-8001 27


C11
C12
R17
R14
R7
C8
Q1
C5
C6
R5
C18
R16
R8
C18
R34
R13
Q4
CR10
R35
Q2
C9
R12
C15
R4
C10
C14
C16
R20
R11
R19
Q17
R18
R26
L11
C17
C20
R28
R24
CR4, CR5,
CR6 & CR7
CR8
Q12
R10
C27
R9
R29
C23
R15
C26
Q13
C24
C28
C22
L12
C7
Q16
R30
C32
C31
C33
Q6
R6
Q5
C35
C34
R37
C30
R31
R38
Q3
R21
C13
C21
C31
R33
R32
R36
R22
CR1
R40
R39

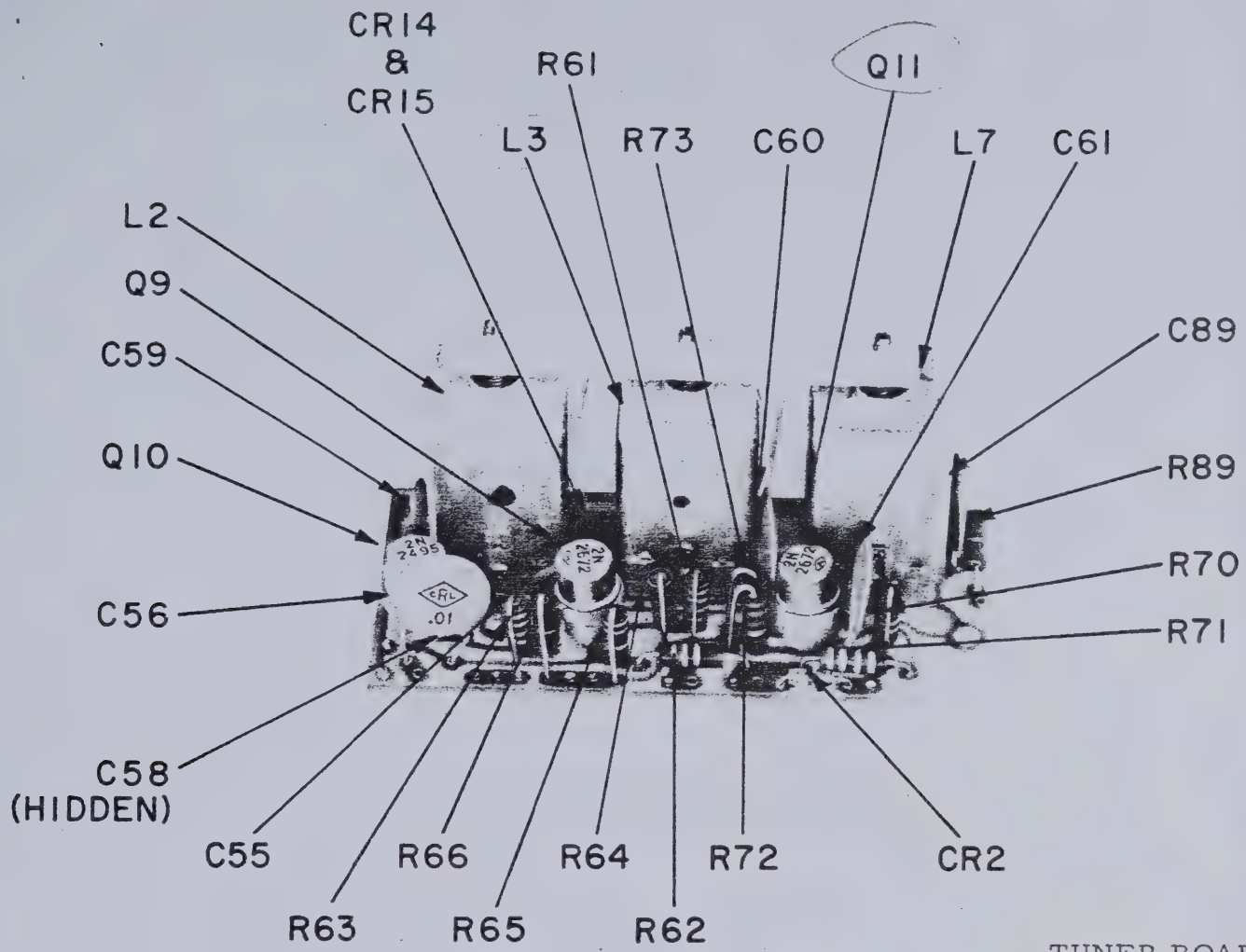
IF BOARD



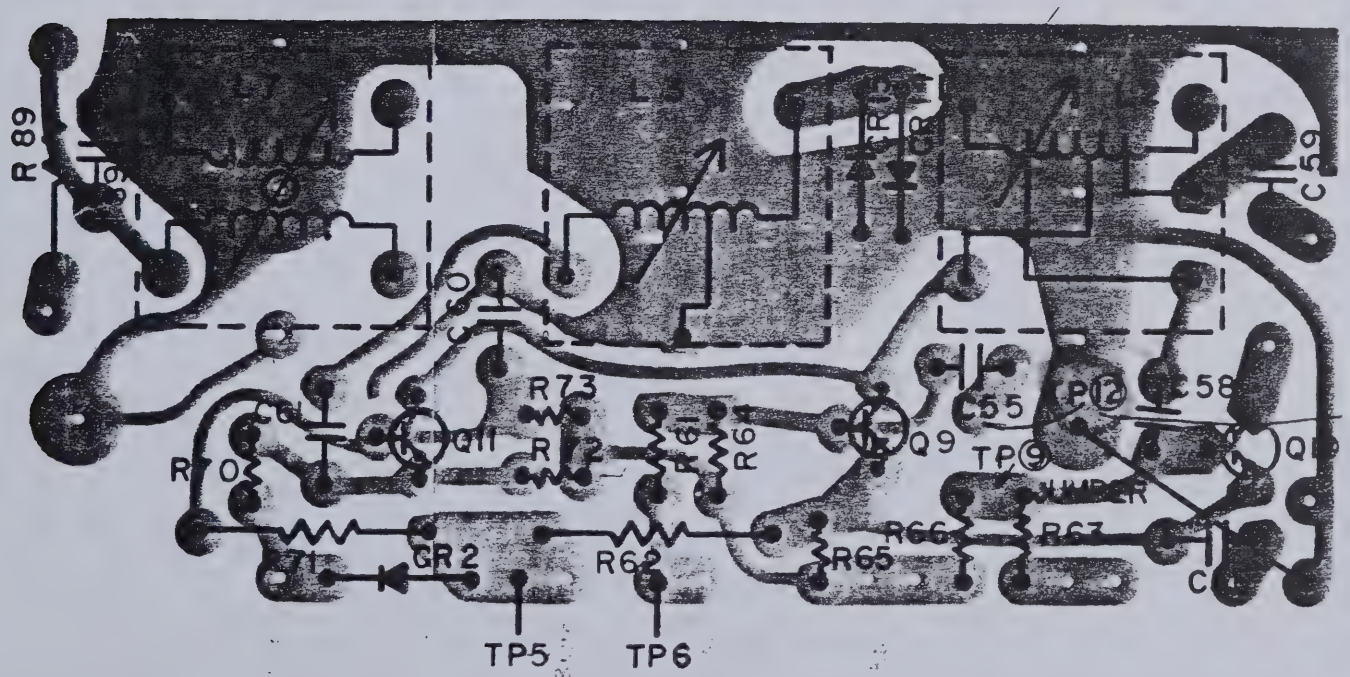
PA CAVITY WITH TUBES REMOVED



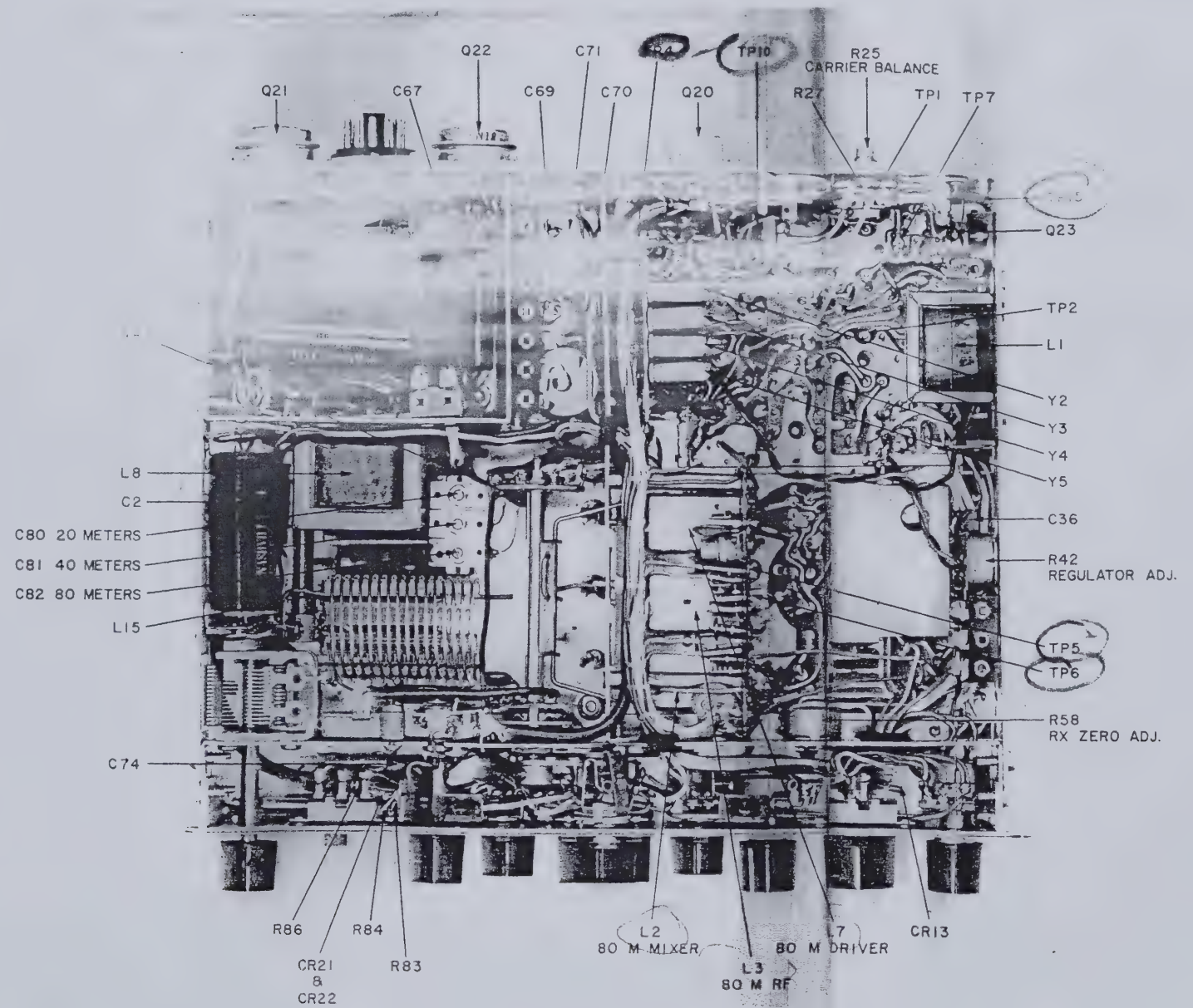
CRYSTAL OSCILLATOR BOARD BOTTOM



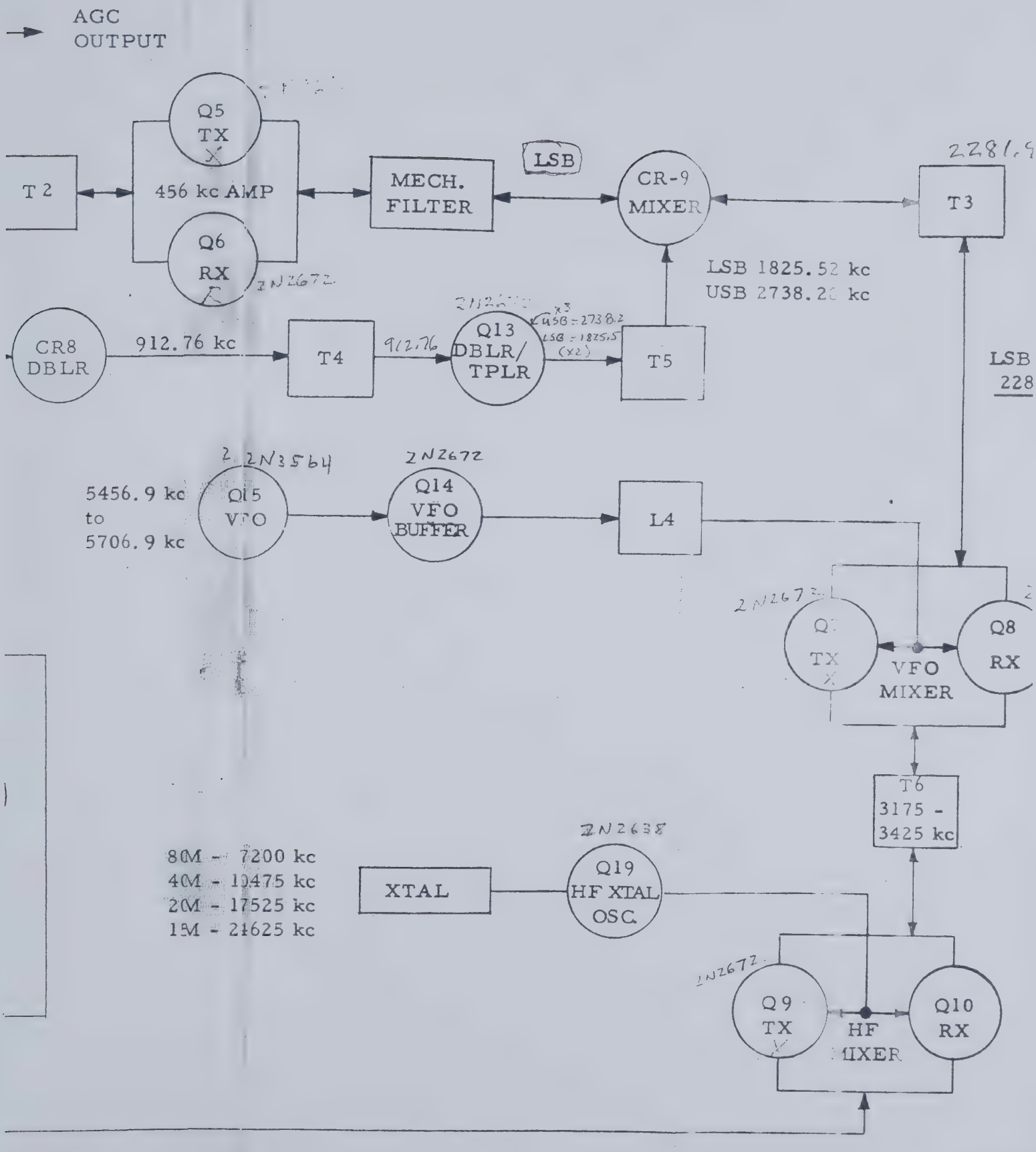
TUNER BOARD

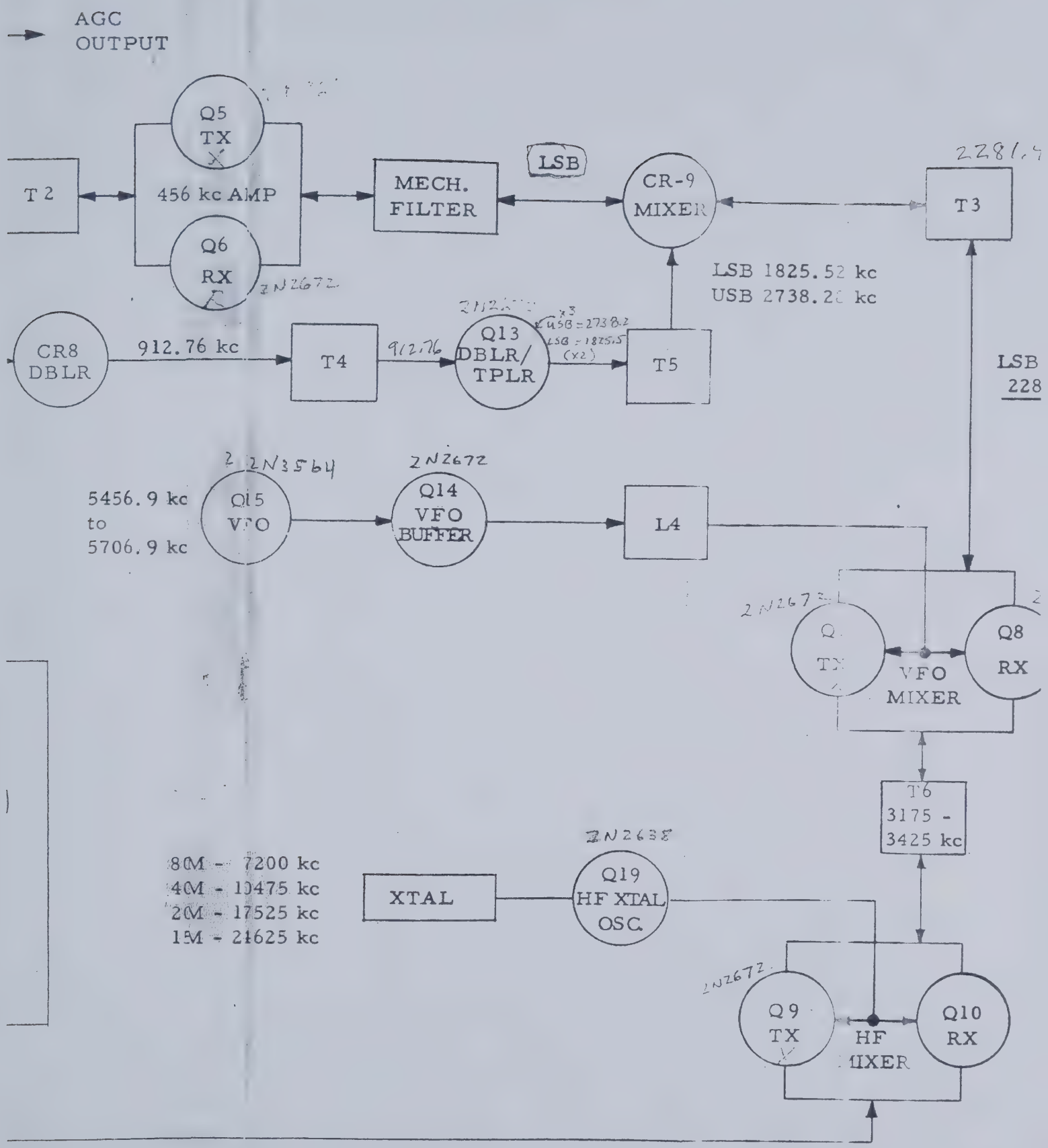


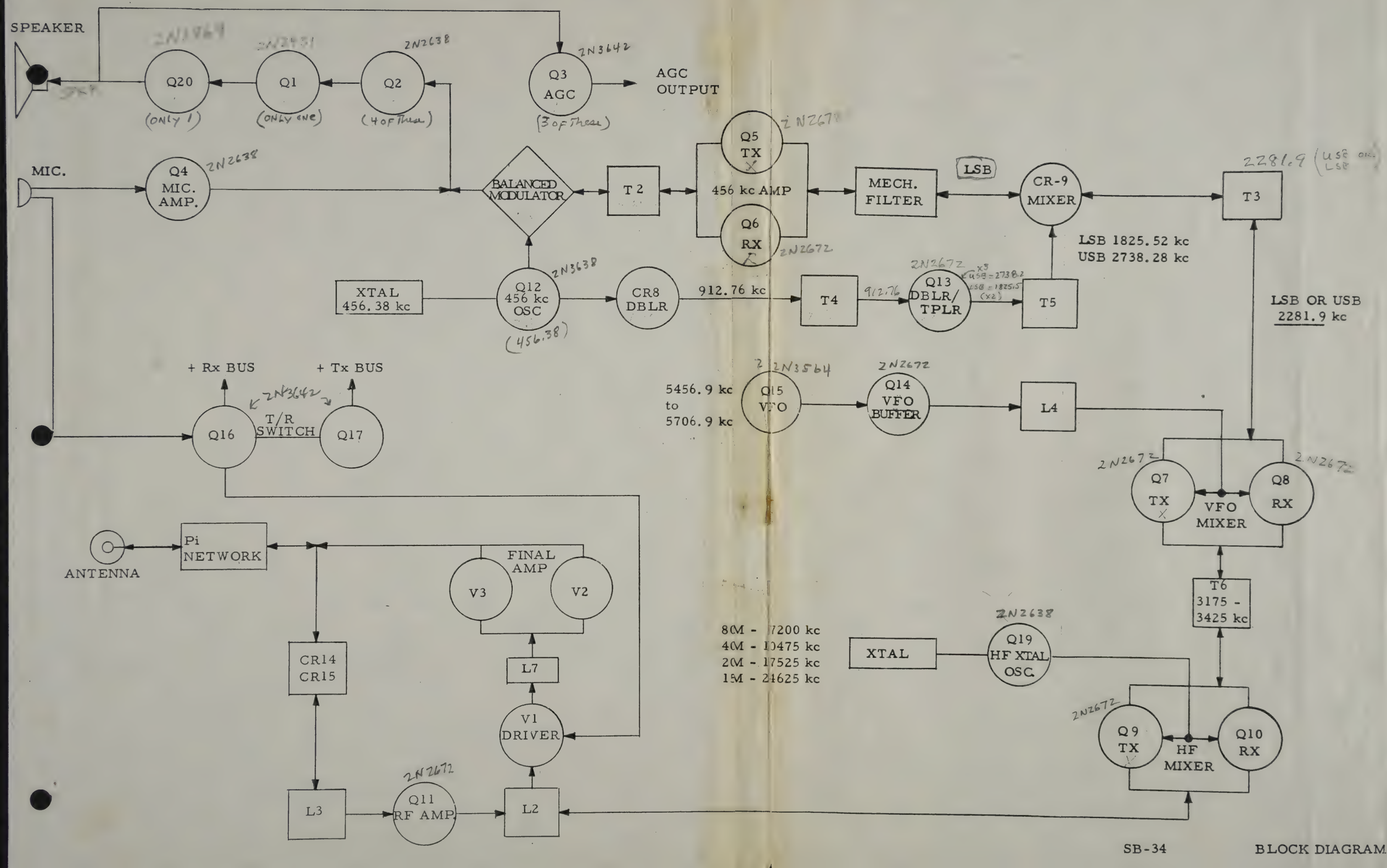
TUNER BOARD BOTTOM

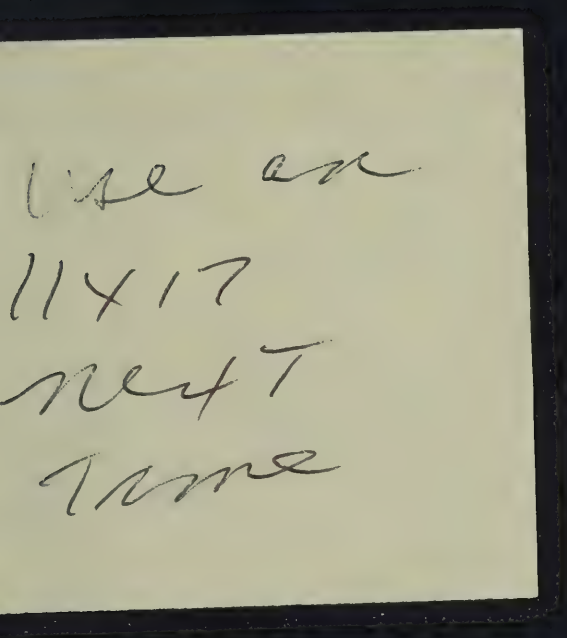


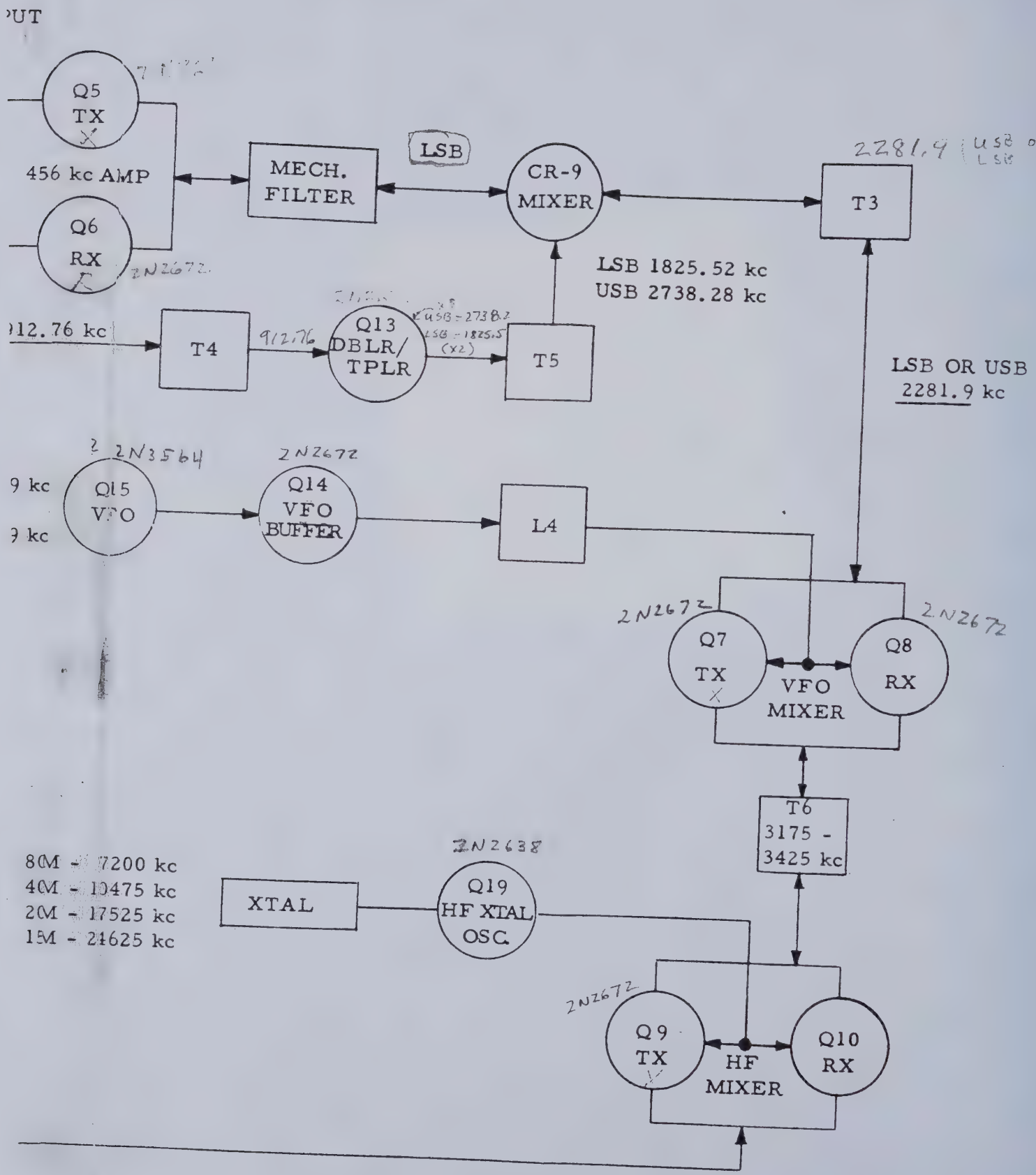
CHASSIS BOTTOM VIEW


AGC OUTPUT
Q5 TX
T2
456 kc AMP
Q6 RX
MECH. FILTER
LSB
CR-9 MIXER
T3
2281.9
LSB 1825.52 kc
USB 2738.28 kc
CR8 DBLR
912.76 kc
T4
912.76
Q13 DBLR/ TPLR
x3 USB = 2738.2
LSB = 1825.5 (x2)
T5
LSB 228
2 2N3564
Q15 VFO
5456.9 kc to 5706.9 kc
2N2672
Q14 VFO BUFFER
L4
2N2673
Q7 TX
VFO MIXER
Q8 RX
T6 3175 - 3425 kc
2N2638
Q19 HF XTAL OSC.
XTAL
80M - 7200 kc
40M - 10475 kc
20M - 17525 kc
15M - 21625 kc
2N2672
Q9 TX
HF MIXER
Q10 RX


AGC OUTPUT
Q5 TX
T2
456 kc AMP
Q6 RX
MECH. FILTER
LSB
CR-9 MIXER
T3
2281.4
LSB 1825.52 kc
USB 2738.28 kc
CR8 DBLR
912.76 kc
T4
912.76
Q13 DBLR/ TPLR
x3 USB = 2738.2 LSB = 1825.5 (x2)
T5
LSB 228
5456.9 kc to 5706.9 kc
Q15 VFO
Q14 VFO BUFFER
L4
Q8 RX
VFO MIXER
T6 3175 - 3425 kc
80M - 7200 kc
40M - 10475 kc
20M - 17525 kc
15M - 21625 kc
XTAL
Q19 HF XTAL OSC.
Q9 TX
HF MIXER
Q10 RX

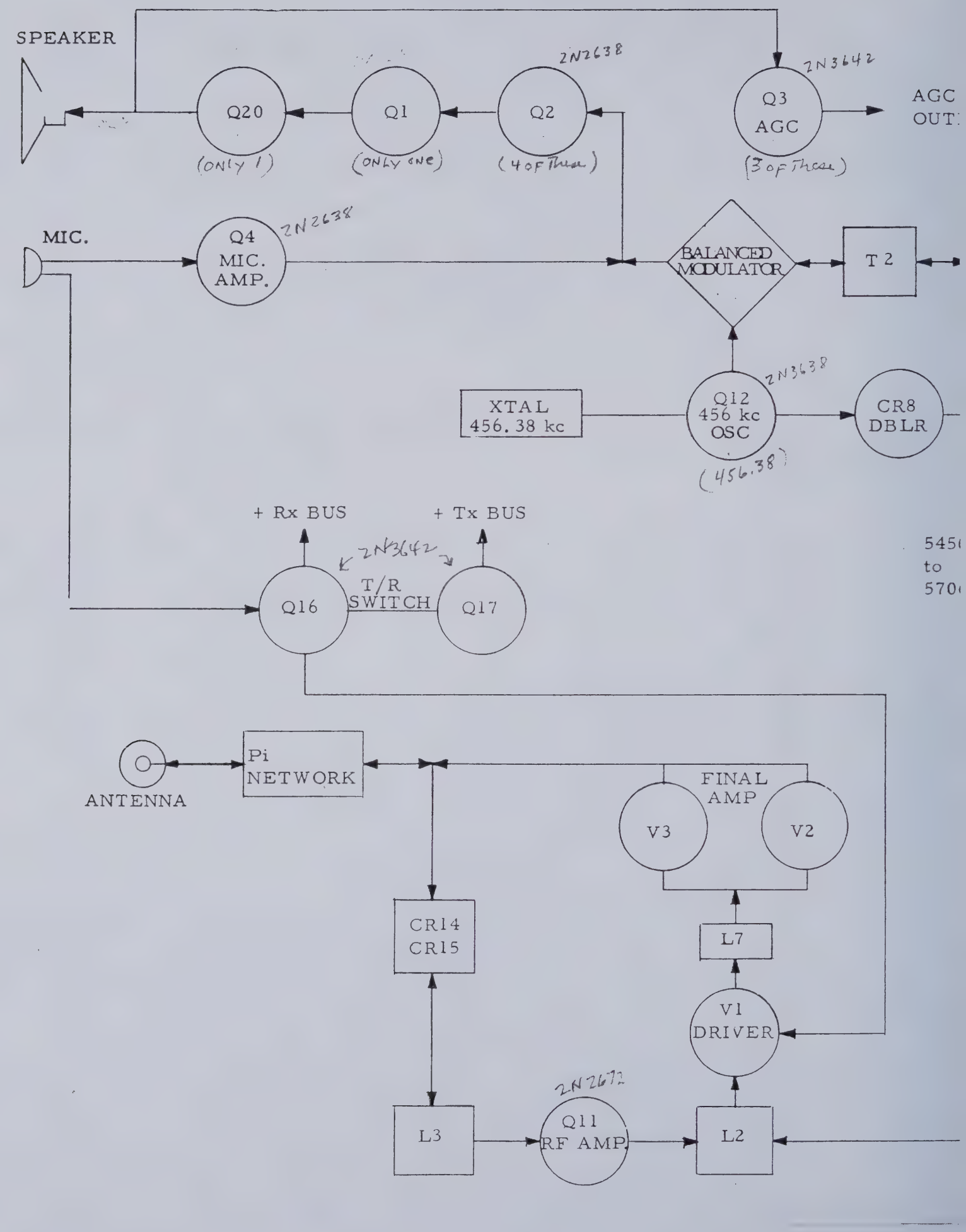

SPEAKER
2N1969
2N2431
2N2638
2N3642
Q20
(ONLY 1)
Q1
(ONLY ONE)
Q2
(4 OF These)
Q3
AGC
(3 of These)
AGC
OUTPUT
MIC.
Q4
MIC.
AMP.
2N2638
BALANCED
MODULATOR
T2
Q5
TX
2N2672
456 kc AMP
Q6
RX
2N2672
MECH.
FILTER
LSB
CR-9
MIXER
2281.9 (USB OR LSB)
T3
LSB 1825.52 kc
USB 2738.28 kc
LSB OR USB
2281.9 kc
XTAL
456.38 kc
Q12
456 kc
OSC
2N3638
(456.38)
CR8
DBLR
912.76 kc
T4
912.76
2N2672
Q13
DBLR/
TPLR
X3 USB = 2738.2
LSB = 1825.5
(x2)
T5
+ Rx BUS
+ Tx BUS
2N3642
Q16
T/R
SWITCH
Q17
5456.9 kc
to
5706.9 kc
2N3564
Q15
VFO
2N2672
Q14
VFO
BUFFER
L4
2N2672
Q7
TX
VFO
MIXER
Q8
RX
2N2672
T6
3175 -
3425 kc
ANTENNA
Pi
NETWORK
FINAL
AMP
V3
V2
L7
V1
DRIVER
CR14
CR15
L3
2N2672
Q11
RF AMP
L2
80M - 7200 kc
40M - 10475 kc
20M - 17525 kc
15M - 24625 kc
XTAL
2N2638
Q19
HF XTAL
OSC.
2N2672
Q9
TX
HF
MIXER
Q10
RX

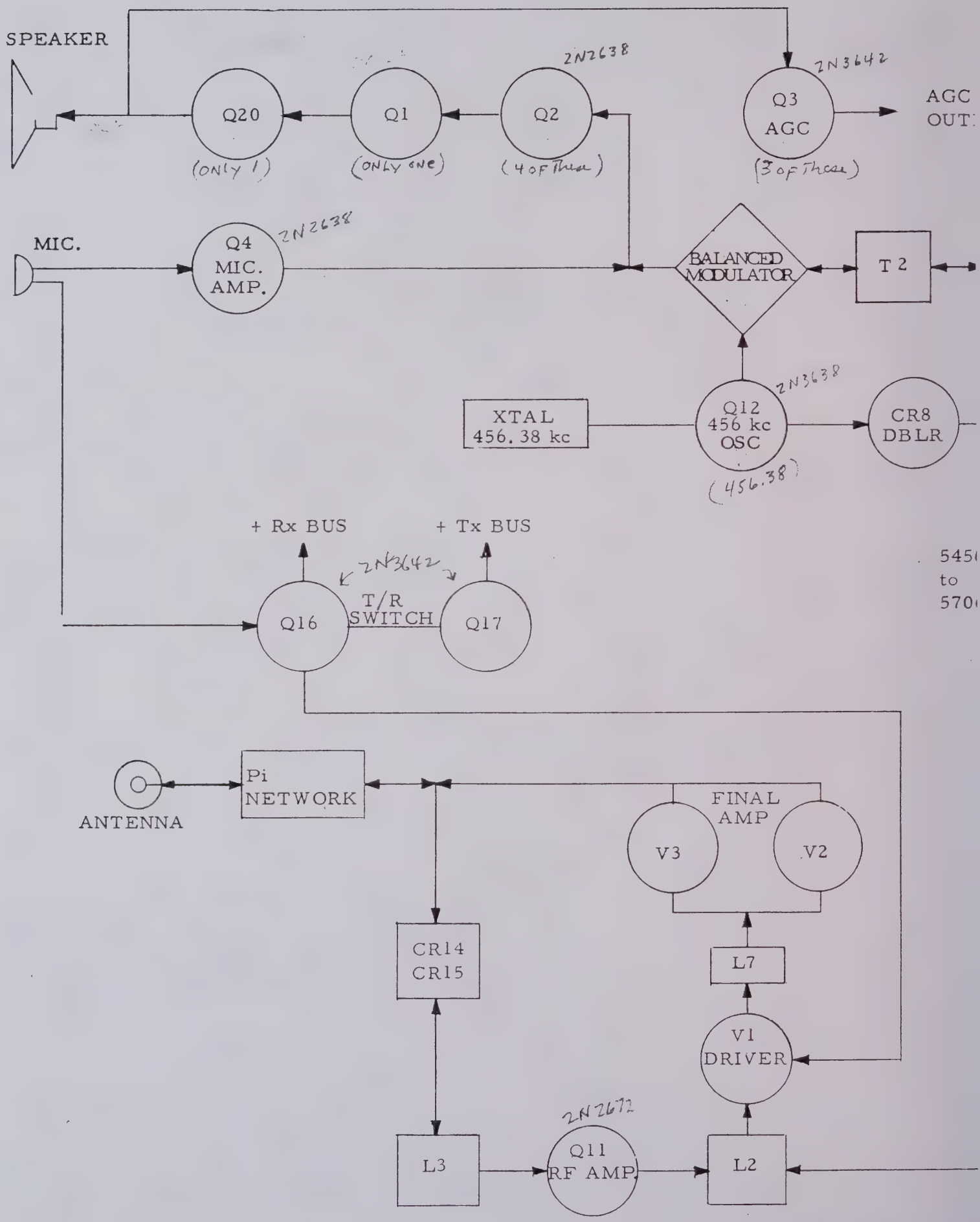




SB-34

BLOCK DIAGRAM


SPEAKER
Q20
(ONLY 1)
Q1
(ONLY ONE)
2N2638
Q2
(4 OF THESE)
2N3642
Q3
AGC
(3 OF THESE)
AGC
OUT
MIC.
Q4
MIC.
AMP.
2N2638
BALANCED
MODULATOR
T 2
XTAL
456.38 kc
Q12
456 kc
OSC
2N3638
(456.38)
CR8
DBLR
+ Rx BUS
+ Tx BUS
2N3642
Q16
T/R
SWITCH
Q17
5450
to
5700
ANTENNA
Pi
NETWORK
FINAL
AMP
V3
V2
CR14
CR15
L7
V1
DRIVER
2N2672
L3
Q11
RF AMP.
L2

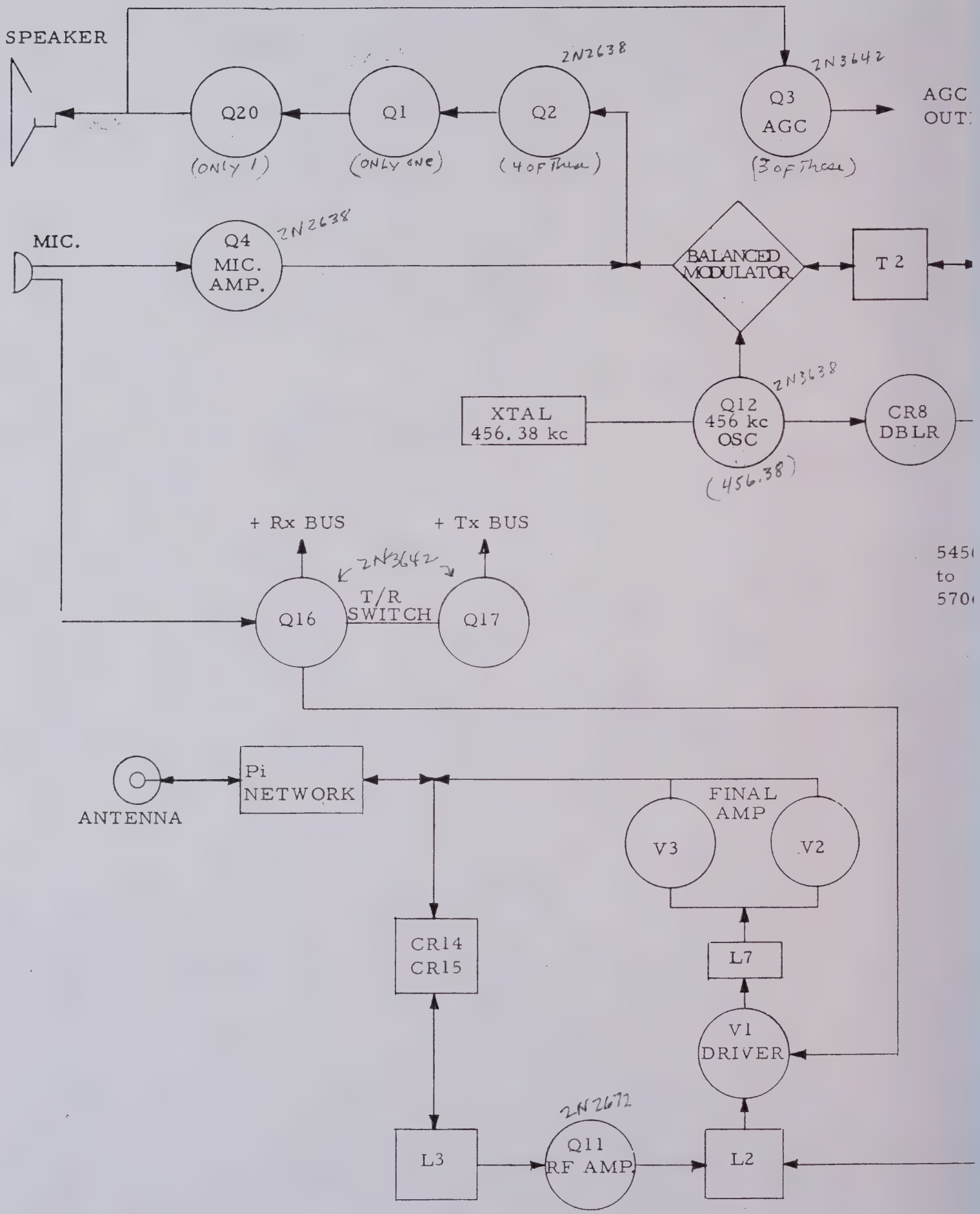

SPEAKER
Q20
(ONLY 1)
Q1
(ONLY ONE)
2N2638
Q2
(4 OF These)
2N3642
Q3
AGC
(3 OF These)
AGC
OUT
MIC.
Q4
MIC.
AMP.
2N2638
BALANCED
MODULATOR
T 2
XTAL
456.38 kc
Q12
456 kc
OSC
(456.38)
2N3638
CR8
DBLR
+ Rx BUS
+ Tx BUS
2N3642
Q16
T/R
SWITCH
Q17
5450
to
5700
ANTENNA
Pi
NETWORK
FINAL
AMP
V3
V2
CR14
CR15
L7
V1
DRIVER
2N2672
L3
Q11
RF AMP.
L2

Symbol	Stock No.	Description
		CAPACITORS
C1, 39, 41, 43, 93, 99	235-7207P39	Ceramic, disc, .1mfd, 100V
C2,3,4	235-7215P43	Electrolytic, tubular, 2000mfd, 20V
C5,7,26,27,36, 42,45,46,50,56, 57,60,61,62,63		
85,87,89,95	235-7195P12	Ceramic, disc, .01mfd, 500V, GMV
C6,10,15,16	235-7189P1	Electrolytic, tubular, 3mfd, 12V
C8	235-7215P1	Electrolytic, tubular, 3mfd, 12V
C9,12,37,94	235-7207P40	Ceramic, disc, .1mfd, 100V
C11	235-7189P4	Electrolytic, 10mfd, 20V
C13,55,58	235-7207P8	Ceramic, disc, 100pfd, 600V
C14,20,51	235-7053P313	Mica, dipped, 390pfd, 500V
C17,29	235-7193P7	Mylar, dipped, .1mfd, 100V
C18,21	235-7189P20	Electrolytic, tubular, 250mfd, 12V
C19, 25	235-7193P7	Mylar, dipped, 0.1mfd
C22	235-7207P6	Ceramic, disc, 56pfd, 600V
C23, 32, C24	235-7263P1	Variable, mica, compression
	235-7053P279	Mica, molded, 270pfd, 500V
C28	235-7207P14	Ceramic, disc, .001mfd, 600V
C30,34,97,98	235-7053P104	Mica, dipped, 150pfd, 300V
C31	235-7193P1	Mylar, dipped, 1000pfd, 100V
C35,40,91	235-7053P317	Mica, dipped, 560pfd, 500V
C38	235-7205P5	Mylar, dipped, .22mfd, 100V
C44	235-7196P61	Ceramic, disc, 15pfd, 500V
C47, 92	235-7200P6	Bakelite, tubular, 1.5pfd, 100V
C48A,B,C	235-7185P1	Variable, 3-gang VFO
C49	235-7196P9	Ceramic, disc, 6.8pfd, 10%, NPO
C52	235-7053P36	Mica, dipped, 33pfd, 5%, 300V
C53	235-7053P44	Mica, dipped, 82pfd, 2%, 500V
C54	235-7260P1	Ceramic, variable, 3-12pfd
C59,74	235-7207P14	Ceramic, disc, .001mfd, 500V
C64	235-7195P60	Ceramic, disc, .002mfd, 1KV
C65,79	235-7196P63	Ceramic, disc, 33pfd, NPO
C66	235-7200P4	Bakelite, tubular, 4.7pfd, 100V
C67,68	235-7215P22	Electrolytic, tubular, 50mfd, 50V
C69	235-7215P33	Electrolytic, tubular, 100mfd, 350V
C70	235-7215P33	Electrolytic, tubular, 100mfd, 350V
C71	235-7215P39	Electrolytic, tubular, 300mfd, 150V
C72,73	235-7215P3	Electrolytic, tubular, 4mfd, 150V
C75	235-7064P5	Mica, dipped, 1100pfd
C76	235-7267P1	Mica, variable, compression, PA load
C77	235-7210P7	Mica, "H" type, .0005 mfd, 10%, 2500V
C78	235-7186P1	Variable, PA tune
C80-81-82	235-7274P1	Mica, variable, compression, 3-sec.

Symbol	Stock No.	Description
C83	235-7212P14	Paper, tubular, .1mfd, 600V
C84, 96	235-7207P25	Ceramic, disc, .0047mfd, 3KV
C86	235-7259P1	Ceramic, neutralizing
C88	235-7053P0	Mica, dipped, 2pfd, 500V
C90, A, B, C,	235-7184P1	Variable, 3-gang
		DIODES
CR1,2,4,5,6, 7,8,21,22	322-7186P3	Germanium, S262
CR9	322-7186P6	Germanium, 1N87A
CR10	322-7175P5	Zener, 7.0V, 5mA
CR11	386-7178P1	Transistor 2N3565
CR12,13	322-7186P2	Germanium 1N270
CR14,15	322-7184P2	Silicon, planar, HE9010
CR17,18,19,20	322-7180P1	Silicon, 1N2071
F1	226-1009P11	FUSE, 3amp, MDL
I-1	277-1013P1	LAMP, 28V, .17A bayonet
		SOCKETS
J-1	276-7195P1	Microphone
J2, 4	282-7185P1	Vox & Calibrator, 7-pin min. tube
J3, 5	276-7250P1	Antenna & Linear amp.
		COILS
L1	292-7200P1	Audio choke
L2	375-7223P1	Tuner (black dot)
L3	375-7223P2	Tuner (red dot)
L4	375-7260P1	VFO buffer
L5	375-7226P1	VFO
L6	375-7224P1	Crystal oscillator
L7	375-7223P3	Tuner (orange dot)
L8	292-7184P1	Filter
L9	375-7221P1	PA tank
L10	375-7183P1	23 mc trap
L11, 12	375-7274P1	RF choke, 1mh
L13, 14	375-7178P1	RF choke, 1mh
L15	375-7220P1	RF choke
M	245-7181P1	METER
P1	276-7269P1	PLUG, power
		TRANSISTORS
Q1	386-7224P1	2N2431
Q2, 4, 19	386-7184P1	2N3638
Q3, 16, 17	386-7185P1	2N3642

is 2N3638 on written sheet

Symbol	Stock No.	Description
Q5,6,7,8,9,11, 12,13,14	386-7219P1	2N2672
Q10	386-7223P1	2N2495
Q15	386-7188P1	2N3564
Q18, 23	386-7214P1	2N2926 is 2N3567 (Motorola)
Q19,	386-7184P1	2N3638
Q20	386-7200P1	2N2869/2N301
Q21,22	386-7205P3	2N443 or AE443 Red
		RESISTORS
		All fixed resistors are 10% carbon, 1/2 watt unless otherwise noted on schematic.
R1	240-7180P1	Microphone Gain Control, 10KΩ
R25	240-7178P1	Carrier balance, 200Ω
R41	240-7181P1	Volume Control, 5000Ω w/switch S5
R42	240-7196P1	Regulator adjust, WW, 50Ω, 2W
R58	240-7206P1	Receiver zero adjust, WW, 1KΩ, 2W
R59	240-7179P1	Pitch control, 1000Ω
R60	240-7179P1	Dial correct, 1000Ω
R79	280-1106P1	Fixed WW, 1Ω, 5W
R81	240-7221P1	Bias control, 10KΩ
		SWITCHES
S1	228-7280P1	Tune-Operate, DPDT slide
S2	228-7280P1	USB-LSB, DPDT slide
S3	228-7278P1	Pitch OFF-ON, SPDT slide, .5-amp, 125V
S4	228-7277P1	Calibrate, SPST slide, 1-amp, 125V
S5		Part of R41
S6	228-7279P1	Transmitter, SPST slide 10-amp, 125
S7, A,B,C	228-7194P1	Rotary Switch Assembly
S8	228-7280P1	Meter, DPDT slide
SP1	352-7177P1	SPEAKER, 3.2Ω
		TRANSFORMERS
T1	292-7199P1	Audio output
T2	375-7222P1	IF, 456Kc (red dot)
T3	375-7222P4	IF, 2281.9Kc
T4	375-7222P2	Doubler (green dot)
T5	375-7222P3	Doubler/Tripler (yellow dot)
T6	375-7222P5	IF, 3350Kc
T7	292-7198P1	Power


SPEAKER
Q20
(ONLY 1)
Q1
(ONLY ONE)
2N2638
Q2
(4 OF THESE)
2N3642
Q3
AGC
(3 OF THESE)
AGC
OUT
MIC.
Q4
MIC.
AMP.
2N2638
BALANCED
MODULATOR
T 2
XTAL
456.38 kc
Q12
456 kc
OSC
(456.38)
2N3638
CR8
DBLR
+ Rx BUS
+ Tx BUS
2N3642
Q16
T/R
SWITCH
Q17
5450
to
5700
ANTENNA
Pi
NETWORK
FINAL
AMP
V3
V2
CR14
CR15
L7
V1
DRIVER
2N2672
L3
Q11
RF AMP
L2

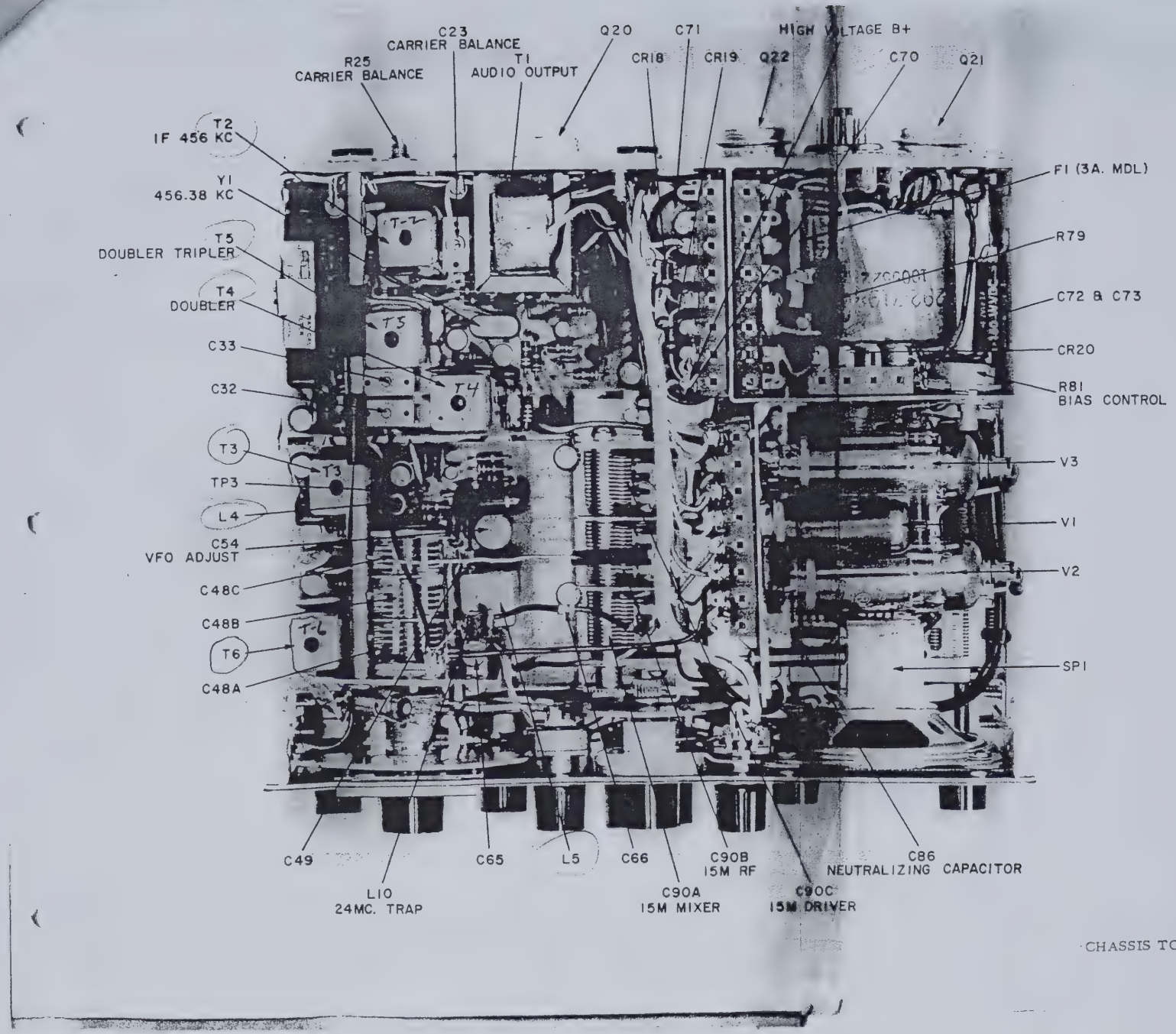
Symbol	Stock No.	Description
		CAPACITORS
C1,39,41,43, 93,99	235-7207P39	Ceramic, disc, .1mfd, 100V
C2,3	235-7215P43	Electrolytic, tubular, 2000mfd, 20V
C4	235-7353P84	Electrolytic, 1000mfd, 25V
C5,7,26,27,36, 42,45,46,50,56 57,60,61,62,63,		
85,87,89,95,101	235-7195P12	Ceramic, disc, .01mfd, 500V
C6,10,15,16	235-7189P1	Electrolytic, tubular, 3mfd, 12V
C8	235-7215P1	Electrolytic, tubular, 3mfd, 12V
C9,12,37,94	235-7207P40	Ceramic, disc, .1mfd, 100V
C11	235-7188P15	Tantalum, 10mfd, 20V
C13,55	235-7207P8	Ceramic, disc, 100pfd, 600V
C14,20,51	235-7053P313	Mica, dipped, 390pfd, 500V
C17,29	235-7193P7	Mylar, dipped, .1mfd, 100V
C18,21	235-7189P20	Electrolytic, tubular, 250mfd, 12V
C19,25	235-7193P7	Mylar, dipped, 0.1mfd
C22	239-7207P6	Ceramic, disc, 56pfd, 600V
C23,32,33	235-7263P1	Variable, mica, compression
C24	235-7053P279	Mica, molded, 270pfd, 500V
C28	235-7207P14	Ceramic, disc, .001mfd, 600V
C30,34,97,98	235-7053P104	Mica, dipped, 150pfd, 300V
C31	235-7193P1	Mylar, dipped, 1000pfd, 100V
C35,40,91	235-7053P317	Mica, dipped, 560pfd, 500V
C38	235-7205P5	Mylar, dipped, .22mfd, 100V
C44	235-7196P61	Ceramic, disc, 15pfd, 500V
C47	235-7200P2	Bakelite, tubular, 1.0pfd, 500V
C48A,B,C	235-7185P1	Variable, 3-gang VFO
C49	235-7196P9	Ceramic, disc, 6.8pfd, 10%, NPO
C52	235-7053P36	Mica, dipped, 33pfd, 5%, 300V
C53	235-7053P44	Mica, dipped, 82pfd, 2%, 500V
C54	235-7260P1	Ceramic, variable, 3-12pfd
C58	235-7207P28	Ceramic, disc, .01mfd, 50V
C59,74	235-7207P14	Ceramic, disc, .001mfd, 500V
C64	235-7195P60	Ceramic, disc, .002mfd, 1KV
C65,79	235-7196P63	Ceramic, disc, 33pfd, NPO
C66	235-7200P4	Bakelite, tubular, 4.7pfd, 100V
C67,68	235-7215P22	Electrolytic, tubular, 50mfd, 50V
C69	235-7215P33	Electrolytic, tubular, 100mfd, 350V
C70	235-7215P33	Electrolytic, tubular, 100mfd, 350V
C71	235-7215P39	Electrolytic, tubular, 300mfd, 150V
C72,73	235-7215P3	Electrolytic, tubular, 4mfd, 150V
C75	235-7064P5	Mica, dipped, 1100pfd
C76	235-7267P1	Mica, variable, compression, PA load
C77	235-7210P20	Mica "H" type, .0004mfd, 10%, 2500V
C78	235-7186P1	Variable, PA tune
C80-81-82	235-7274P1	Mica, variable, compression, 3-sec.

Symbol	Stock No.	Description
C83	235-7212P14	Paper, tubular, .1mfd, 600V
C84,96	235-7207P25	Ceramic, disc, .0047mfd, 3KV
C86	235-7259P1	Ceramic, neutralizing
C88	235-7053P	Mica, dipped, 2pfd, 500V
C90,A,B,C	235-7184P1	Variable, 3-gang
C92	235-7200P	Bakelite, tubular, 1.5pfd, 100V
C102	235-7193P57	Mylar, dipped, .1mfd, 100V
C103	235-7193P54	Mylar, dipped, .02mfd, 100V
C104	235-7193P57	Mylar, dipped, .1mfd, 100V
		DIODES
CR1,2,4,5,6, 7,8,21,22	322-7186P3	Germanium, S262
CR9	322-7186P6	Germanium, 1N87A
CR10	322-7175P5	Zener, 7.0V, 5mA
CR11	386-7178P1	Transistor 2N3565
CR12,13	322-7186P2	Germanium, 1N270
CR14,15	322-7184P2	Silicon, planar, HE9010
CR17,18,19,20	322-7180P1	Silicon, 1N2071
F1	226-1009P11	FUSE, 3amp, MDL
I-1	277-1013P1	LAMP, 28V, .17A bayonet
		SOCKETS
J-1	276-7195P1	Microphone
J2,4	282-7185P1	Vox & Calibrator, 7-pin min. tube
J3,5	276-7250P1	Antenna & Linear amp.
		COILS
L1	292-7200P1	Audio choke
L2	375-7223P1	Tuned (black dot)
L3	375-7223P2	Tuned (red dot)
L4	375-7260P1	VFO buffer
L5	375-7226P1	VFO
L6	375-7224P1	Crystal oscillator
L7	375-7223P3	Tuned (orange dot)
L8	292-7184P1	Filter
L9	375-7221P1	PA tank
L10	375-7183P1	23 mc trap
L11,12	375-7274P1	RF choke, 1mh
L13,14	375-7178P1	RF choke, 1mh
L15	375-7220P1	RF choke
M	245-7181P1	METER
P1	276-7269P1	PLUG, power
		TRANSISTORS
Q1	386-7224P1	2N2431
Q2,4 (12),19	386-7184P1	2N3638

Other printed list shows this as a 2N2672

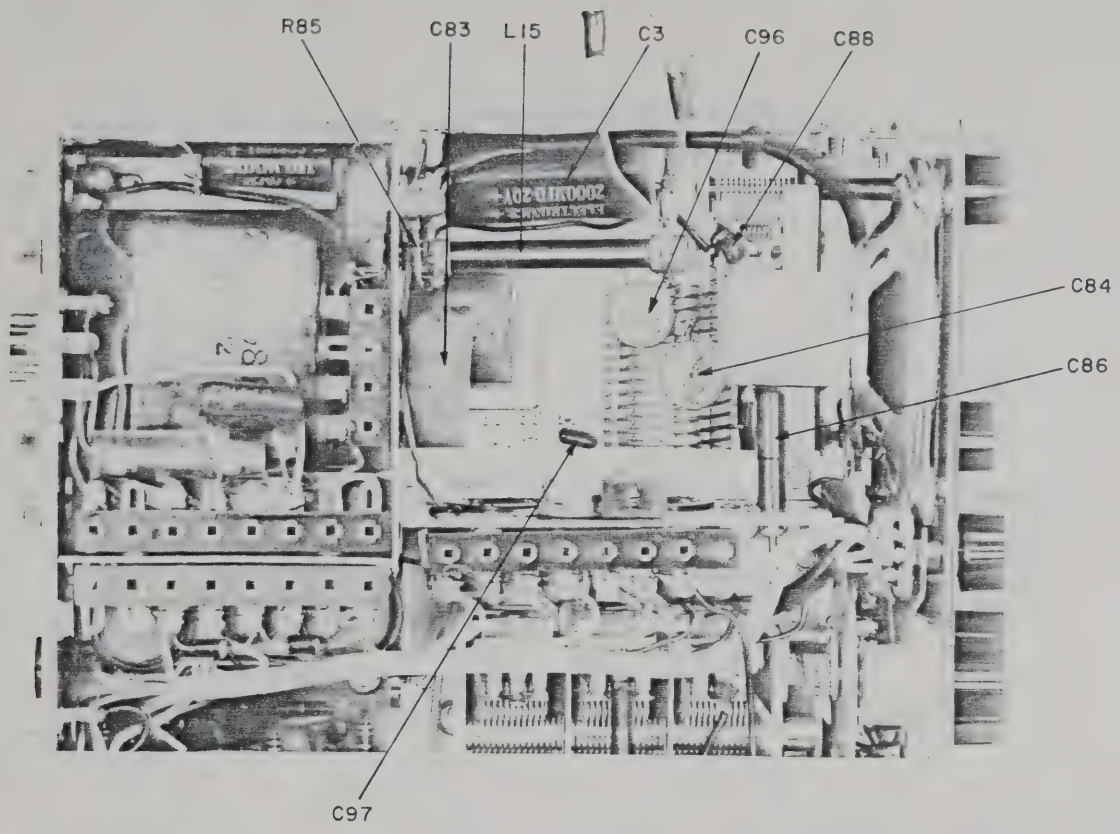
Symbol	Stock No.	Description
Q3,16,17	386-7185P1	2N3642
Q5,6,7,8,9,11, 13,14	386-7219P1	2N2672
Q10	386-7223P1	2N2495
Q15	386-7188P1	2N3564
Q18,23	386-7177P1	2N3567 YES ON Q18
Q19	386-7184P1	2N3638
Q20	386-7200P1	2N2869/2N301 6822?
Q21,22	386-7205P3	2N443 or AE443 Red
		RESISTORS
		All fixed resistors are 10% carb 1/2 watt unless otherwise noted schematic.
R1	240-7180P1	Microphone Gain Control, 10KΩ
R25	240-7178P1	Carrier balance, 200Ω
R41	240-7181P1	Volume Control, 500Ω w/switch S
R42	240-7196P1	Regulator adjust, WW, 50Ω, 2W
R58	240-7206P1	Receiver zero adjust, WW, 1KΩ, 2
R59	240-7179P1	Pitch control, 1000Ω
R60	240-7179P1	Dial correct, 1000Ω
R79	280-1106P1	Fixed WW, 1Ω, 5W
R81	240-7221P1	Bias control, 10KΩ
		SWITCHES
S1	228-7280P1	Tune-Operate, DPDT slide
S2	228-7280P1	USB-LSB, DPDT slide
S3	228-7278P1	Pitch OFF-ON, SPDT slide, .5-amp 125V
S4	228-7277P1	Calibrate, SPST slide, 1-amp, 125 Part of R41
S6	228-7279P1	Transmitter, SPST slide, 10-amp,
S7,A,B,C	228-7194P1	Rotary Switch Assembly
S8	228-7280P1	Meter, DPDT slide
SP1	352-7177P1	SPEAKER, 3.2Ω
		TRANSFORMERS
T1	292-7199P1	Audio output
T2	375-7222P1	IF, 456Kc (red dot)
T3	375-7222P4	IF, 2281.9Kc
T4	375-7222P2	Doubler (green dot)
T5	375-7222P3	Doubler/Tripler (yellow dot)
T6	375-7222P5	IF, 3350Kc
T7	292-7198P1	Power

Symbol	Stock No.	Description
		TUBES
V1	2[illegible]P2	12DQ7
V2, 3	2[illegible]P1	6GB5
		CRYSTALS
Y1	[illegible]P1	456.38Kc
Y2	3[illegible]P1	7200Kc (80 meter)
Y3	3[illegible]P1	10475Kc (40 meter)
Y4	[illegible]P1	17525Kc (20 meter)
Y5	[illegible]P1	24625Kc (15 meter)
		MISCELLANEOUS
	[illegible]5G1	Cabinet, complete w/handle
	[illegible]2P1	Cable, DC, W-70
	[illegible]3P1	Cable, AC, W-71
	[illegible]5P1	Clamp, Mech. Filter
	[illegible]6P1	Dial, Frequency
	7167-027P1	Dial, Bezel
	7267-023P1	Dial, Window
	[illegible]7-047G1	Geneva Wheel assembly
	[illegible]1G1	Geneva Plate assembly
	[illegible]2P1	Grill, speaker
	[illegible]G1	Handle, w/mounting clips
	[illegible]P4	Knob, small round
	[illegible]P2	Knob, large round, tuning
	[illegible]P2	Knob, pointer, bandswitch
	[illegible]P1	Mechanical Filter
	[illegible]26P1	Panel, Front overlay
	[illegible]5P1	Shaft, extension for C76
	[illegible]3P1	Shield, top
	[illegible]P1	Shield, bottom
	[illegible]P1	Shield, VFO board
	[illegible]P1	Socket, transistor, small
	[illegible]P1	Socket, transistor, power
	[illegible]P1	Socket, tube V-1
	[illegible]P2	Socket, tube V-2-3
		Tuner Slug Assembly Parts
	[illegible]P1	Ferrite slug (L-2-3-7)
	[illegible]P2	Slug connecting rod, nylon
	[illegible]P1	Yoke, wire
	[illegible]P1	Yoke Keeper, wire
	[illegible]P1	Yoke attachment bracket
	[illegible]P1	Vernier Drive, dual, ball
	[illegible]6G2	I.F. Printed Circuit Board (less mechanical Filter)



CHASSIS TOP VIEW

Symbol	Stock No.	Description
		TUBES
V1	290-7247P2	12DQ7
V2, 3	290-7215P1	6GB5
		CRYSTALS
Y1	394-7189P1	456.38Kc
Y2	394-7185P1	7200Kc (80 meter)
Y3	394-7186P1	10475Kc (40 meter)
Y4	394-7187P1	17525Kc (20 meter)
Y5	394-7188P1	24625Kc (15 meter)
		MISCELLANEOUS
	7267-5005G1	Cabinet, complete w/handle
	7267-7012P1	Cable, DC, W-70
	7267-7013P1	Cable, AC, W-71
	7267-1065P1	Clamp, Mech. Filter
	7267-1045P1	Dial, Frequency
	7267-1027P1	Dial, Bezel
	7267-1028P1	Dial, Window
	7267-1047G1	Geneva Wheel assembly
	7251-1021G1	Geneva Plate assembly
	7267-1042P1	Grill, speaker
	231-7221G1	Handle, w/mounting clips
	231-7192P4	Knob, small round
	231-7196P2	Knob, large round, tuning
	231-7191P2	Knob, pointer, bandswitch
	369-7174P1	Mechanical Filter
	7267-1026P1	Panel, Front overlay
	7267-1035P1	Shaft, extension for C76
	7267-1063P1	Shield, top
	7267-1062P1	Shield, bottom
	7267-1064P1	Shield, VFO board
	386-7193P1	Socket, transistor, small
	386-7194P1	Socket, transistor, power
	282-7196P1	Socket, tube V-1
	282-7194P2	Socket, tube V-2-3
		Tuner Slug Assembly Parts
	297-7182P1	Ferrite slug (L-2-3-7)
	7251-1062P2	Slug connecting rod, nylon
	7267-1038P1	Yoke, wire
	7251-1024P1	Yoke Keeper, wire
	7251-1026P1	Yoke attachment bracket
	7267-1041P1	Vernier Drive, dual, ball
	7267-5016G2	I.F. Printed Circuit Board (less mechanical Filter)



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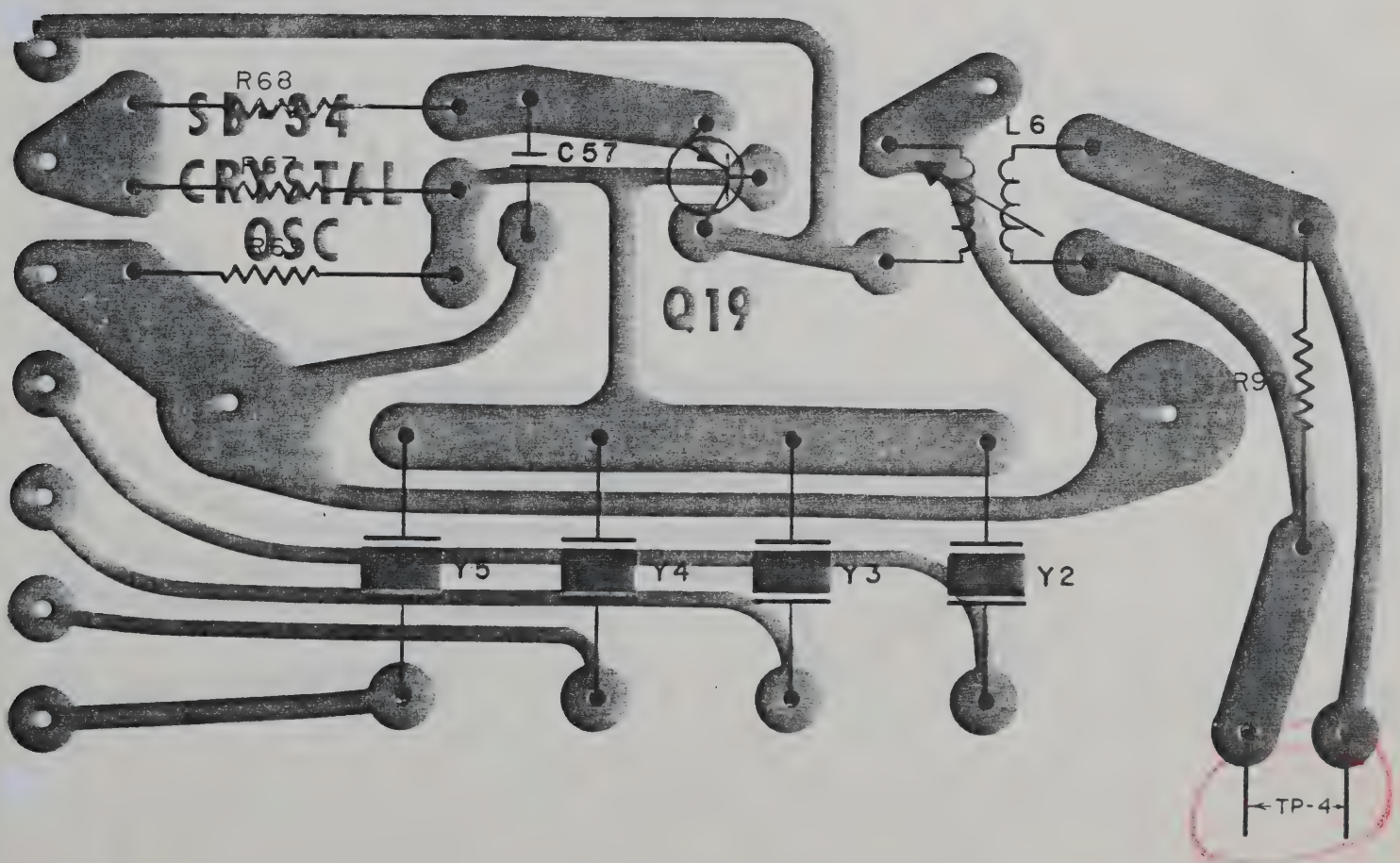
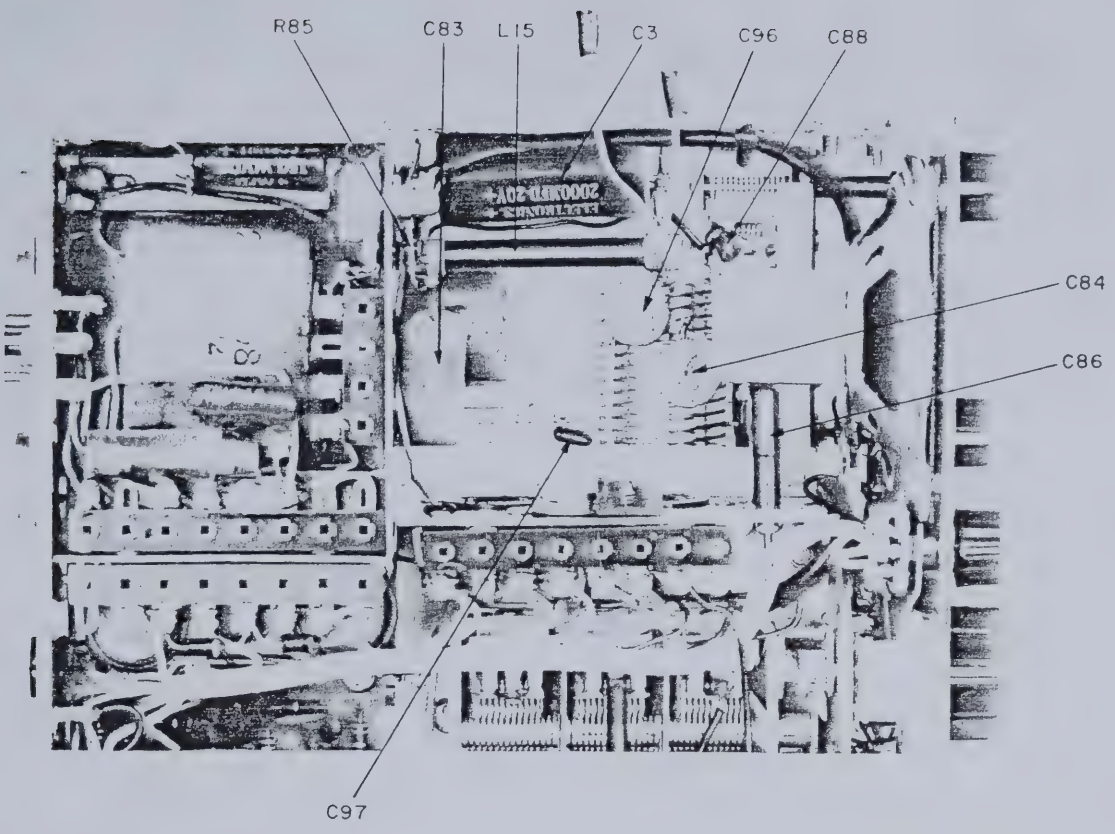
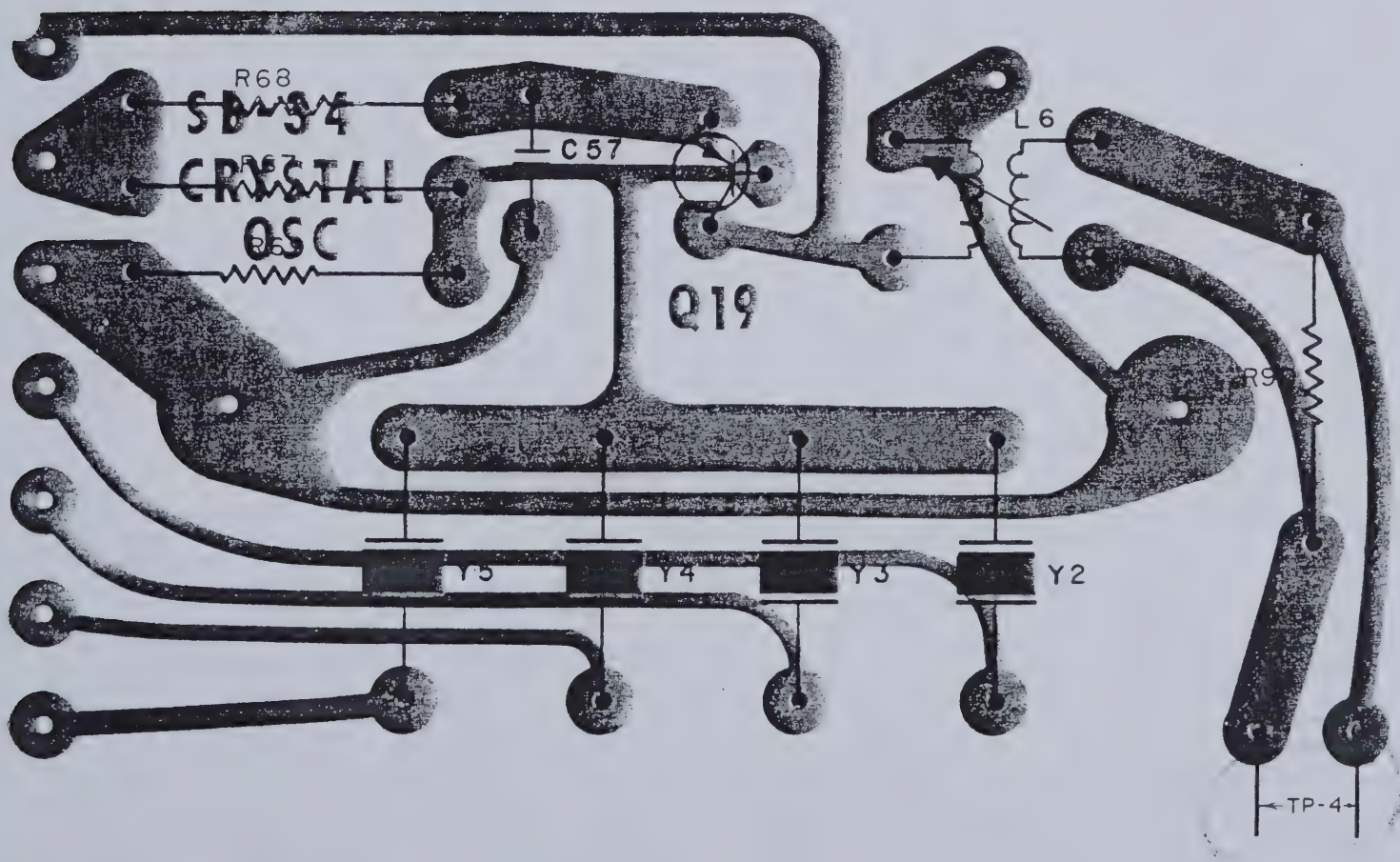


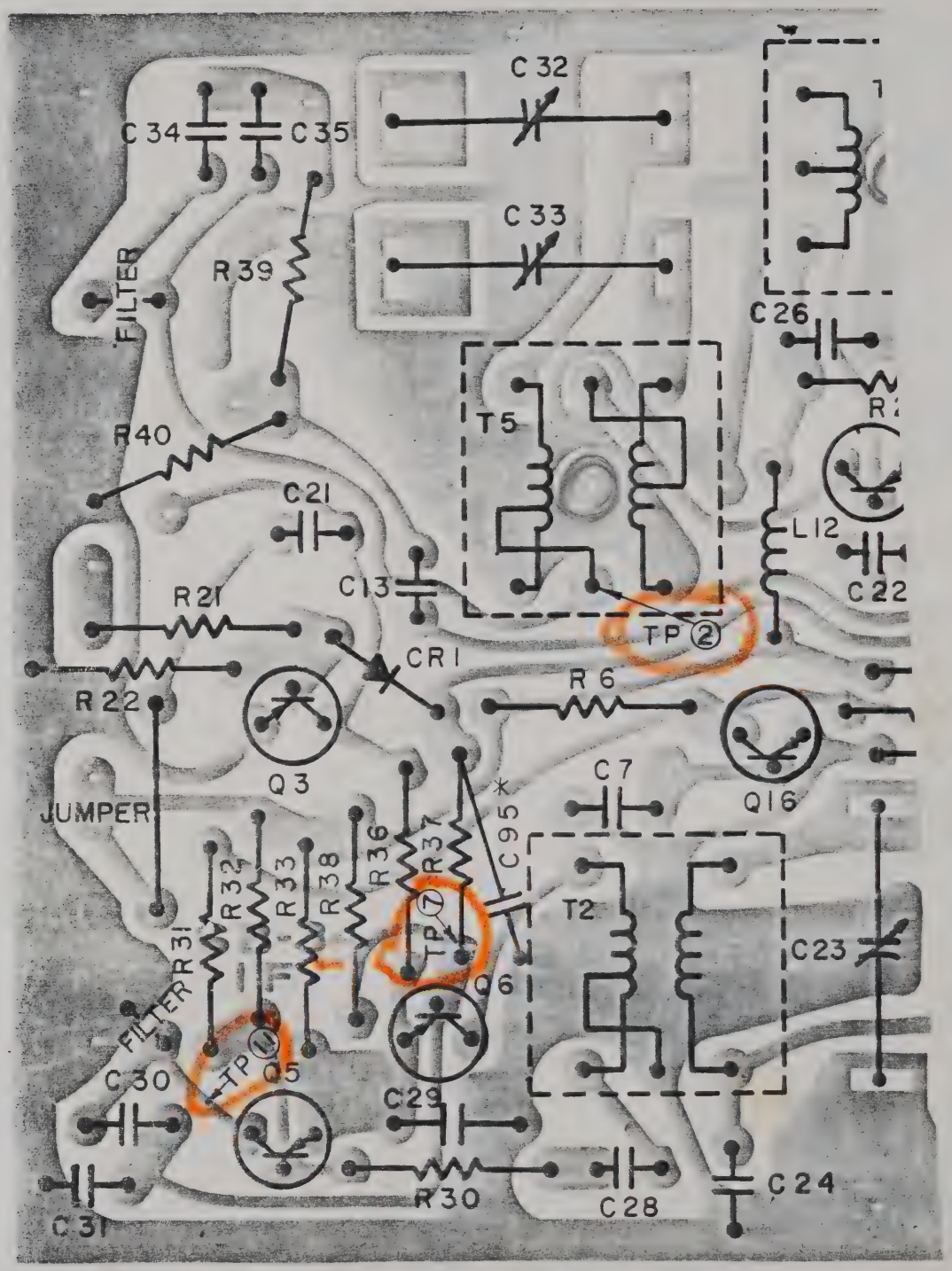
CRYSTAL OSCILLATOR BOARD BOTTOM



PA CAVITY WITH TUBES REMOVED

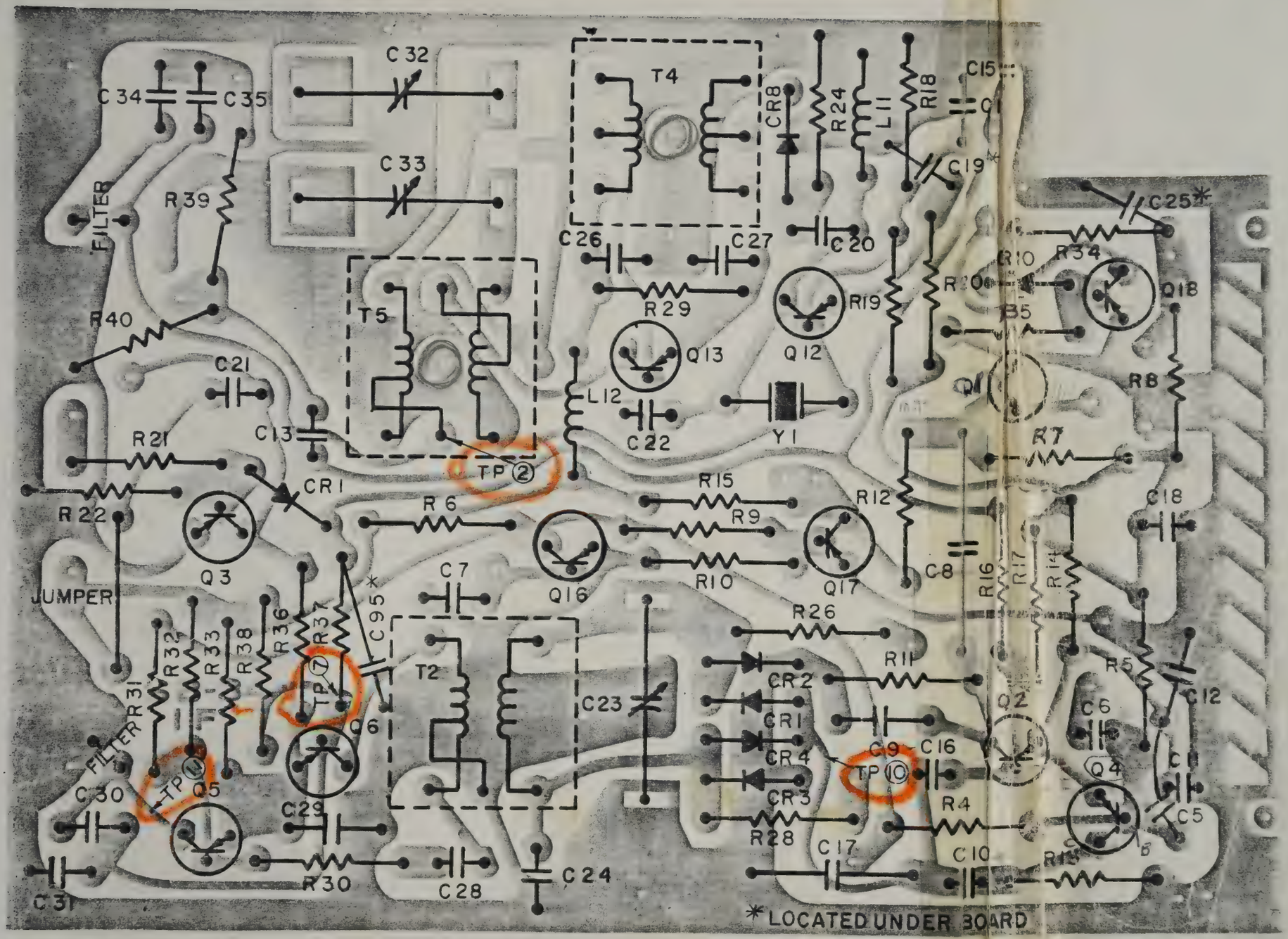


CRYSTAL OSCILLATOR BOARD BOTTOM



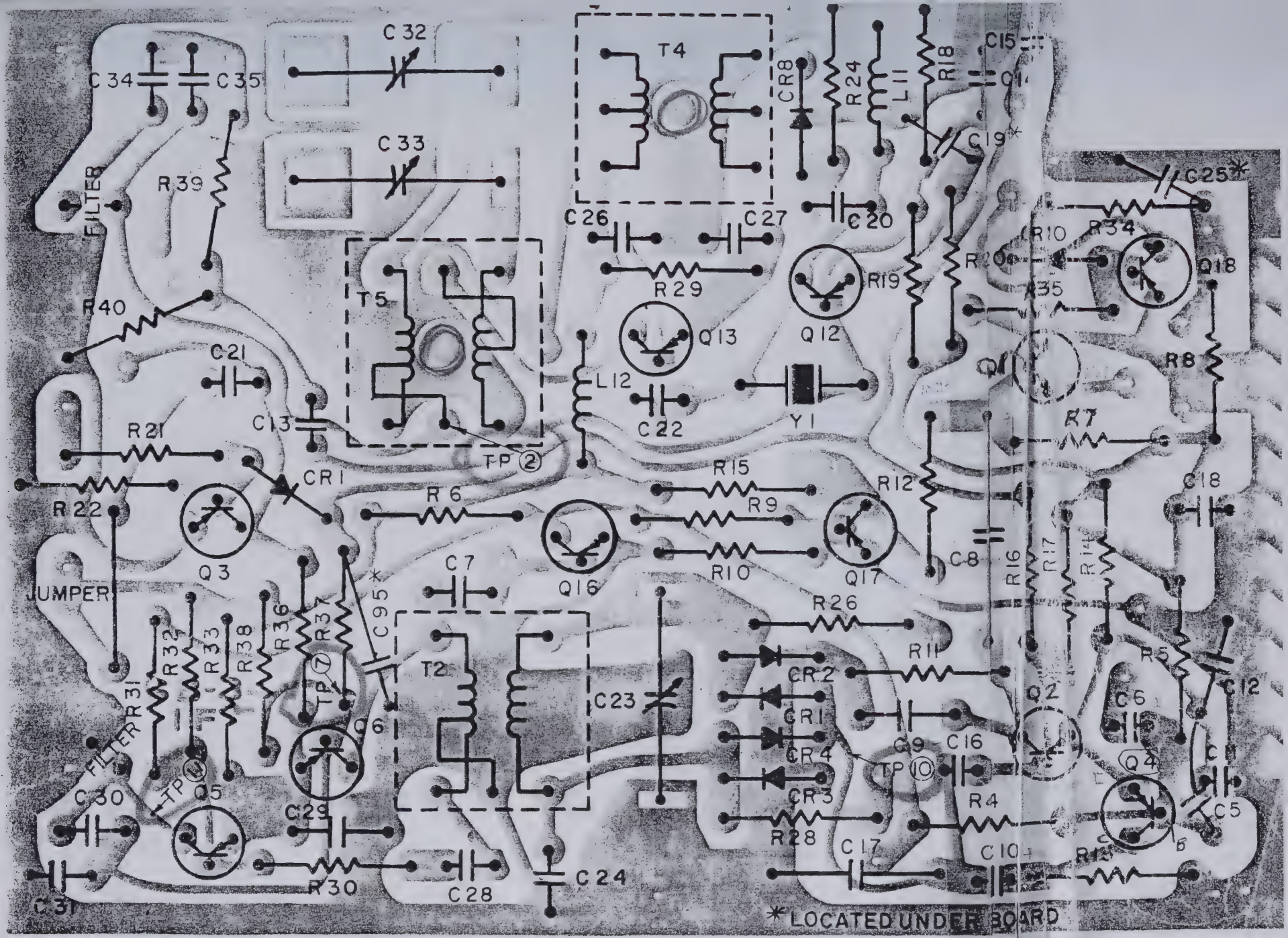
IF BOARD B

C13 - NE

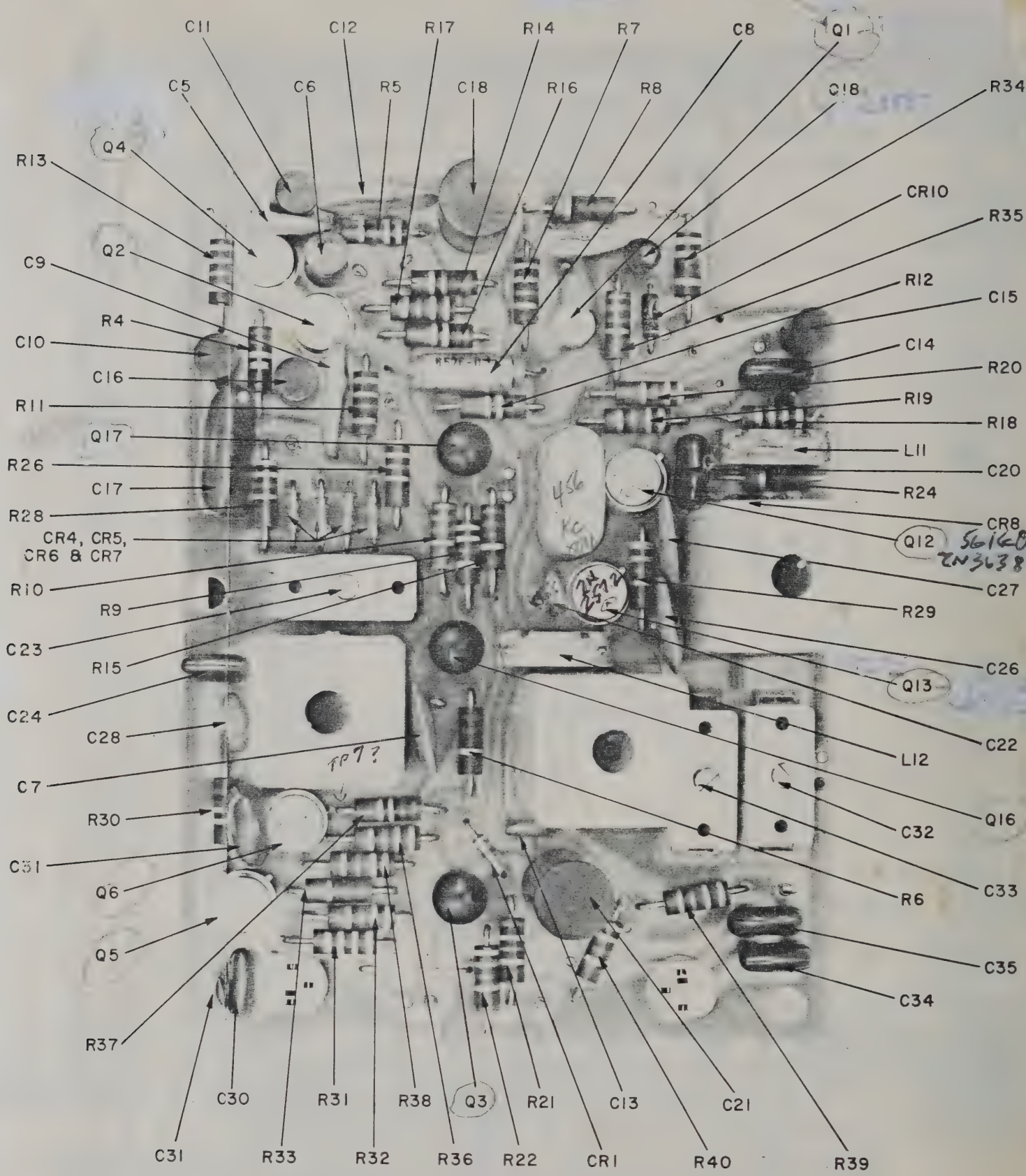


IF BOARD BOTTOM

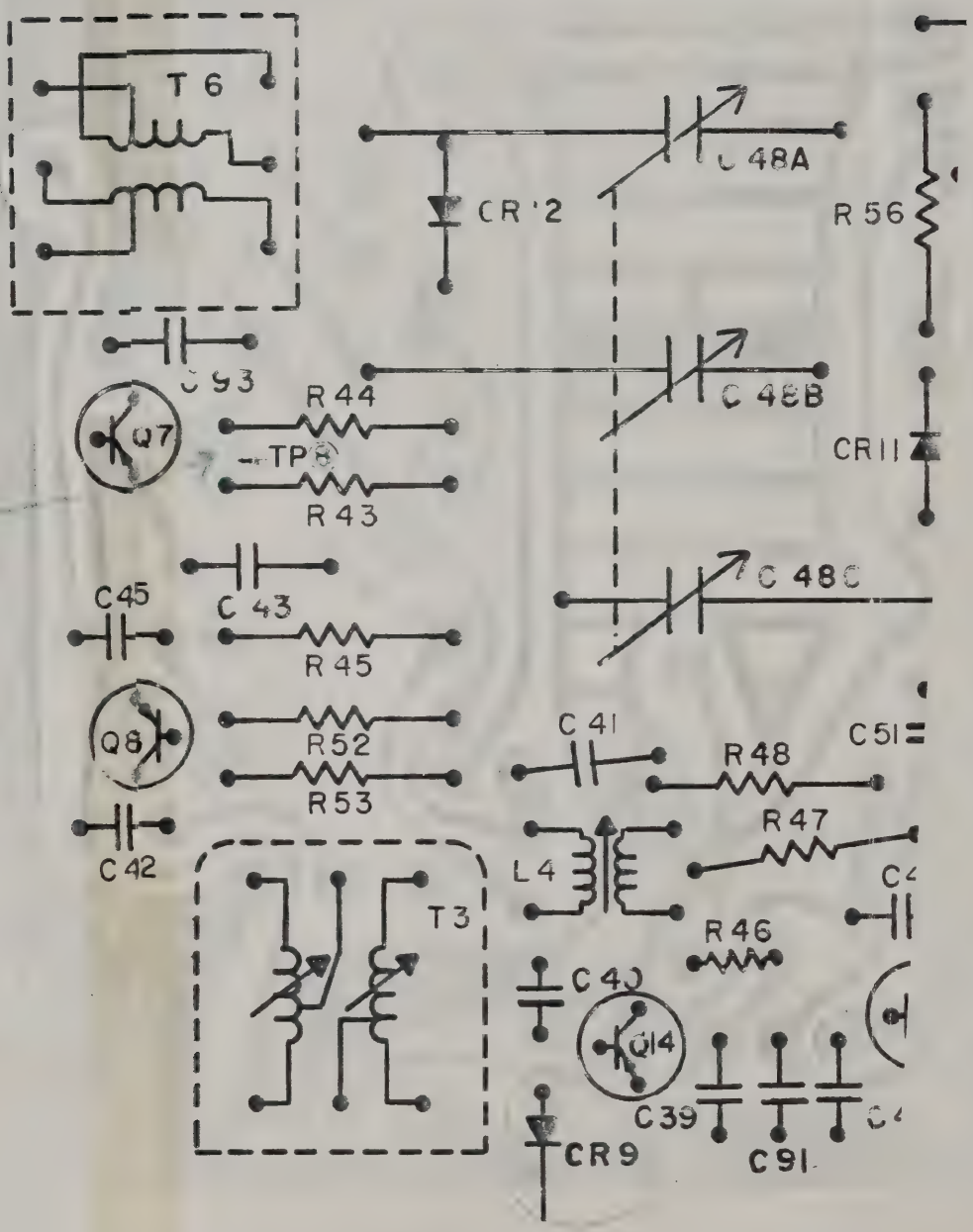
C13 - NP and in Fine



IF BOARD BOTTOM

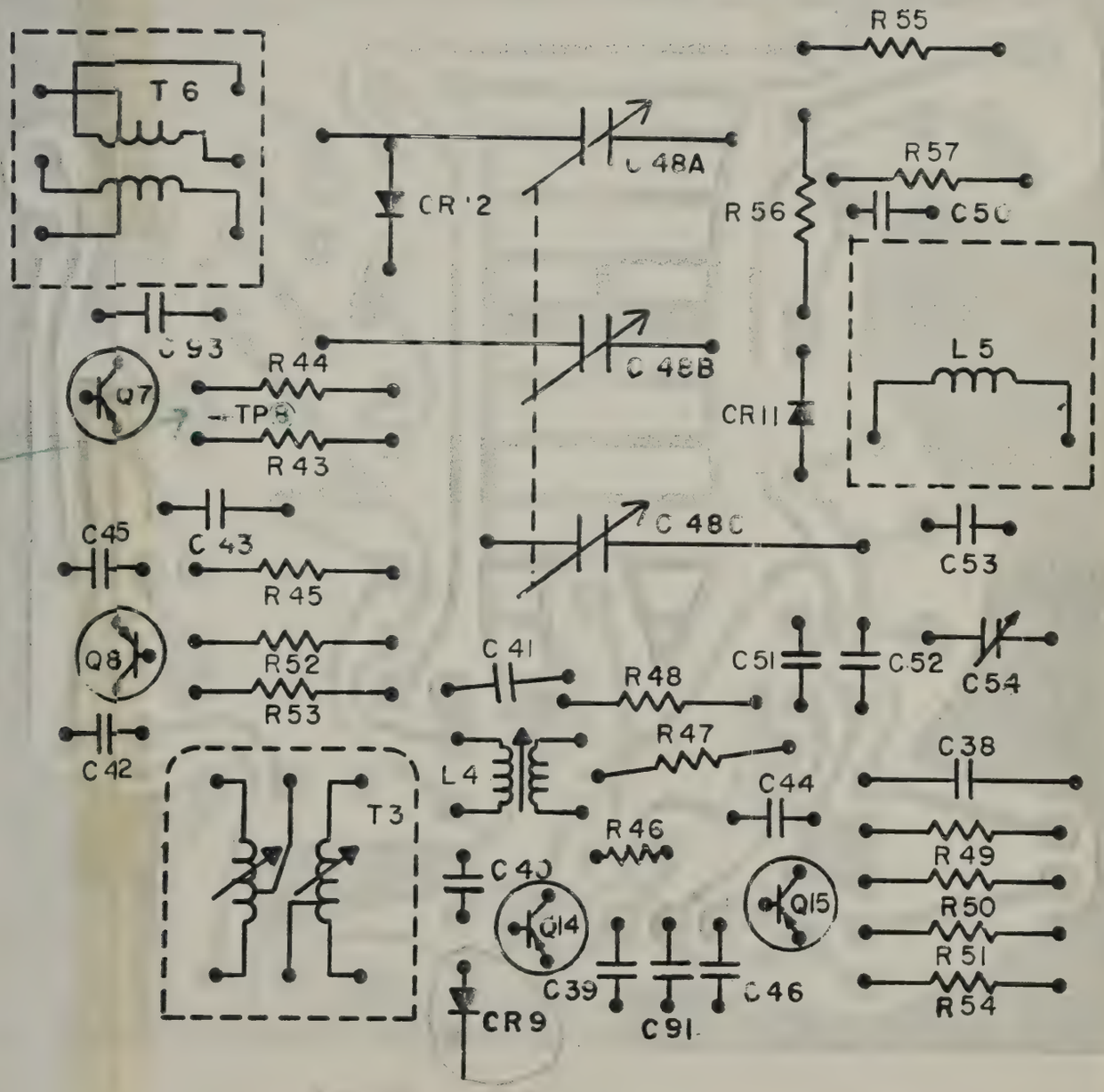

C11
C12
R17
R14
R7
C8
Q1
C5
C6
R5
C18
R16
R8
Q18
R34
Q4
R13
CR10
R35
Q2
C9
R12
C15
R4
C10
C14
C16
R20
R11
R19
Q17
R18
R26
L11
C17
C20
R24
R28
CR8
CR4, CR5, CR6 & CR7
Q12
2N3638
R10
C27
R9
R29
C23
C26
R15
Q13
C24
C28
C22
C7
L12
Q16
R30
C32
C31
C33
Q6
R6
Q5
C35
C34
R37
C30
R31
R38
Q3
R21
C13
C21
C31
R33
R32
R36
R22
CR1
R40
R39

IF BOARD



TOP (SET ON SIDE)

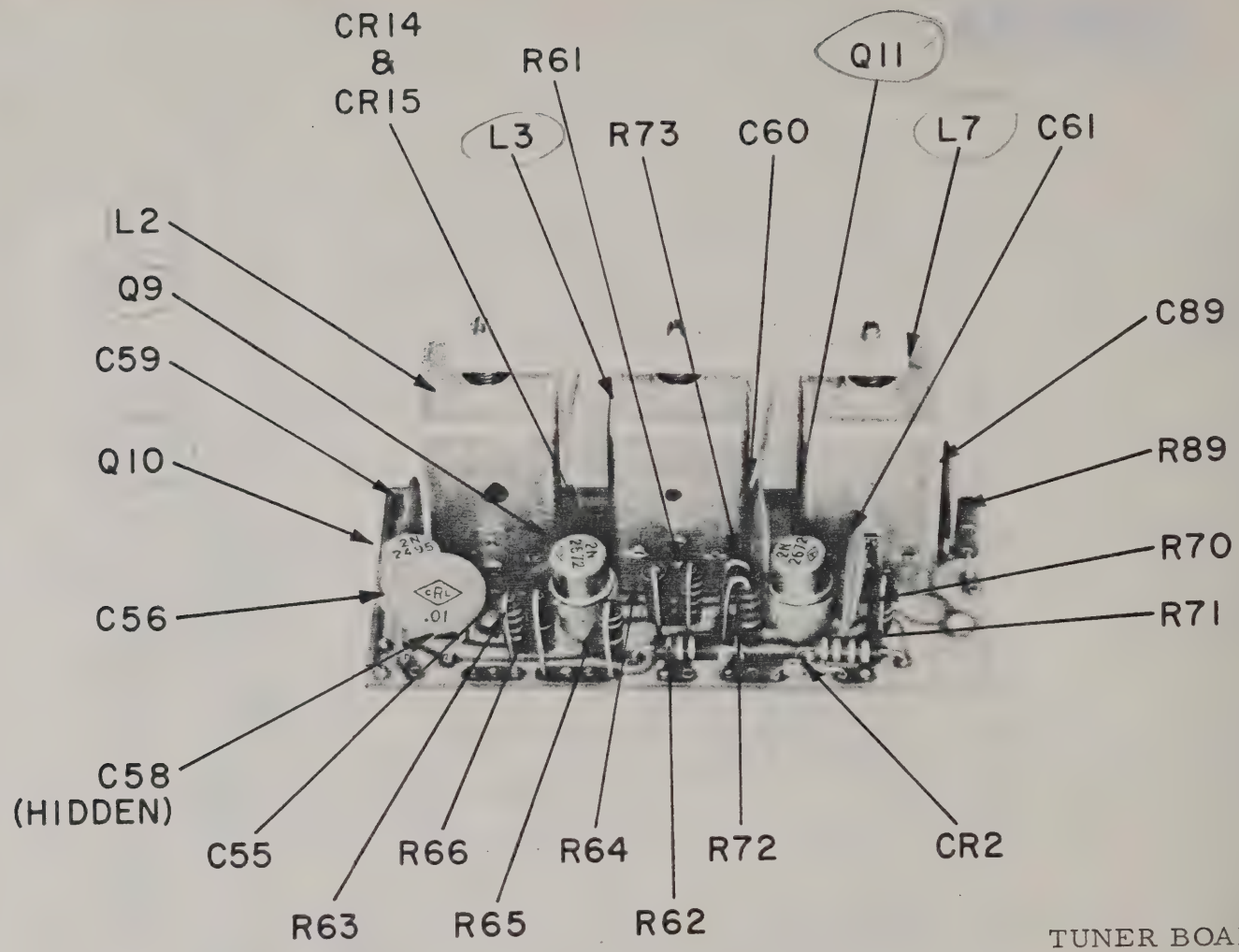
VFO BOARD BOTTO



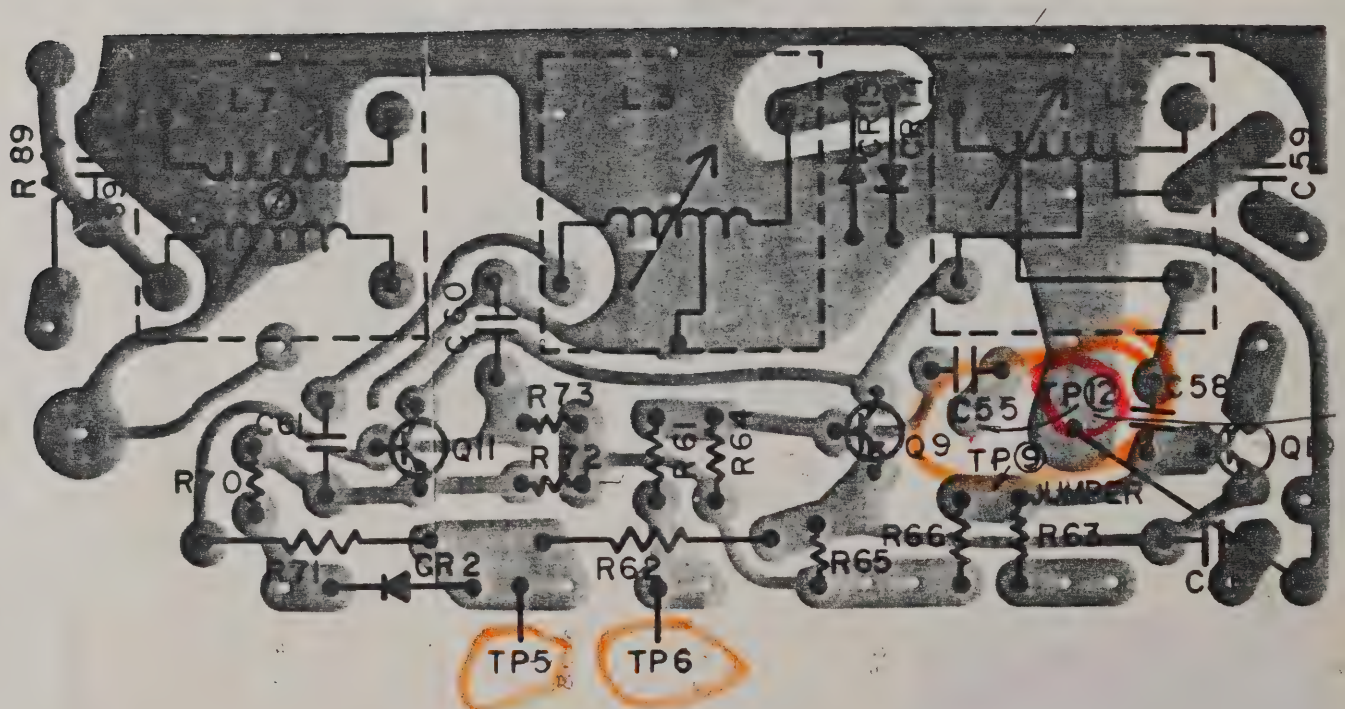
VFO BOARD BOTTOM

TOP (SET ON SIDE)

BOTTOM



TUNER BOARD

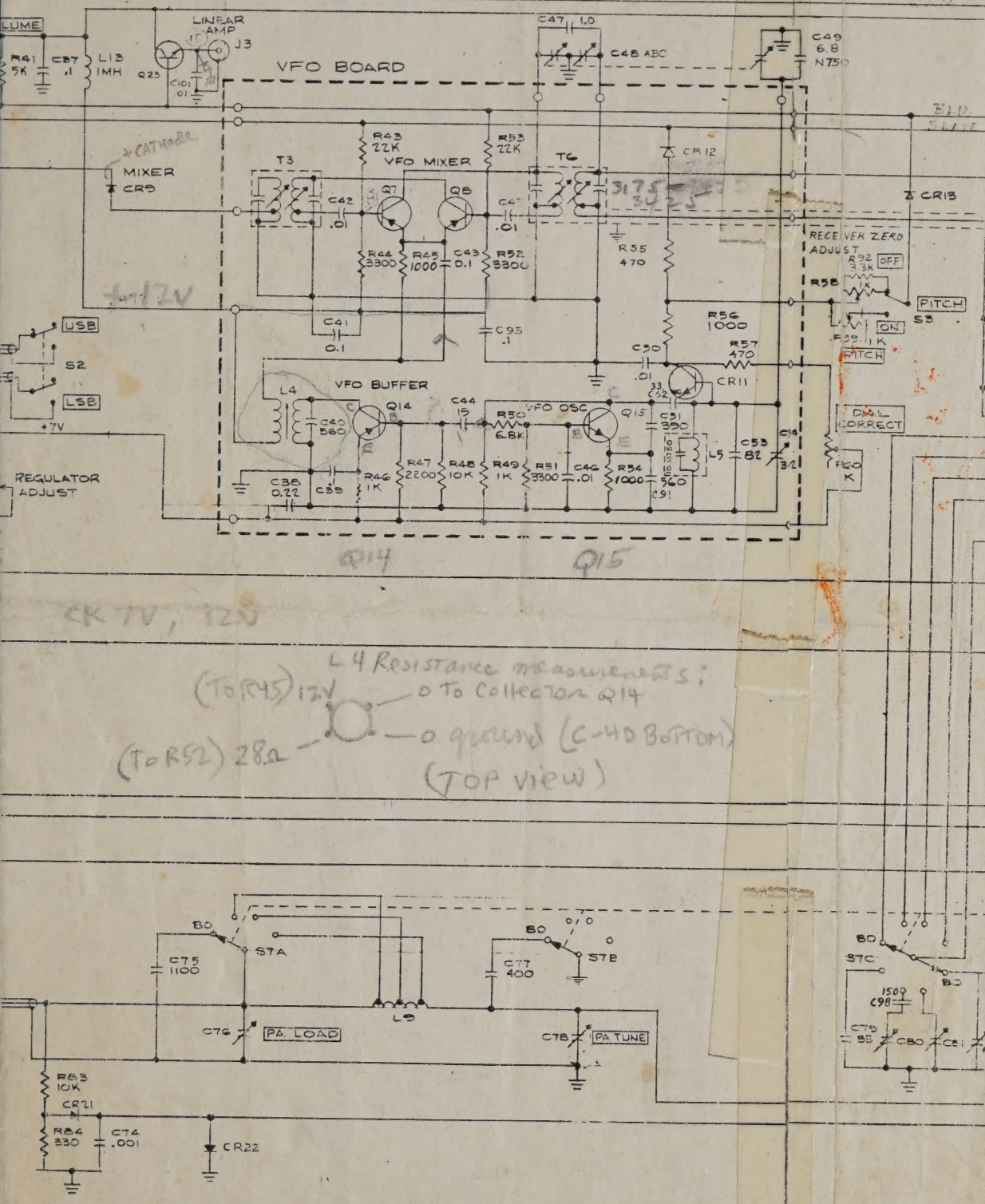


TUNER BOARD BOTTOM

Ken Woodard
WA4BVW

Q23 ↓

Q7 = XMTR
Q8 = RCVR
} 2N2692



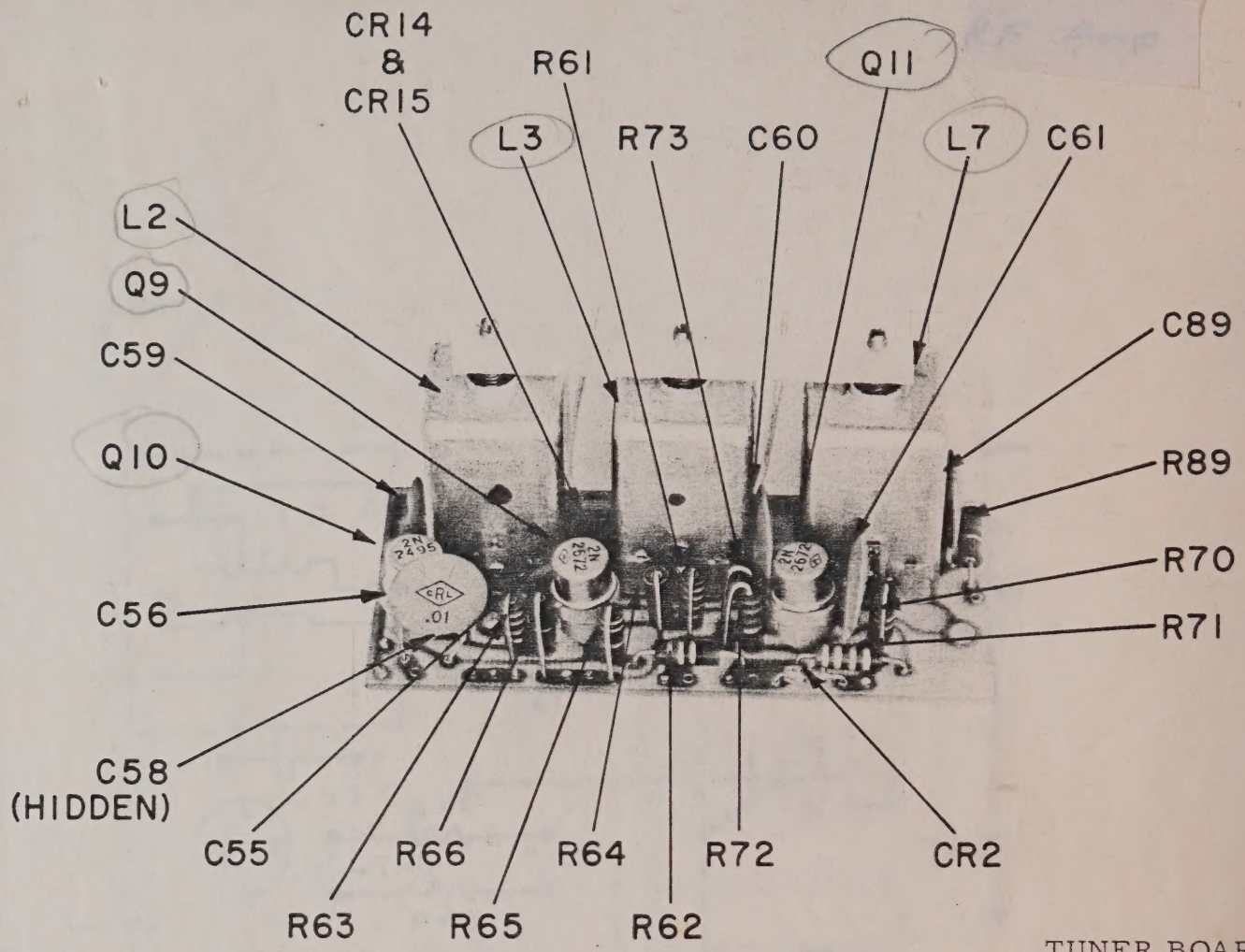
CK TV, T2V

L4 Resistance measurements:

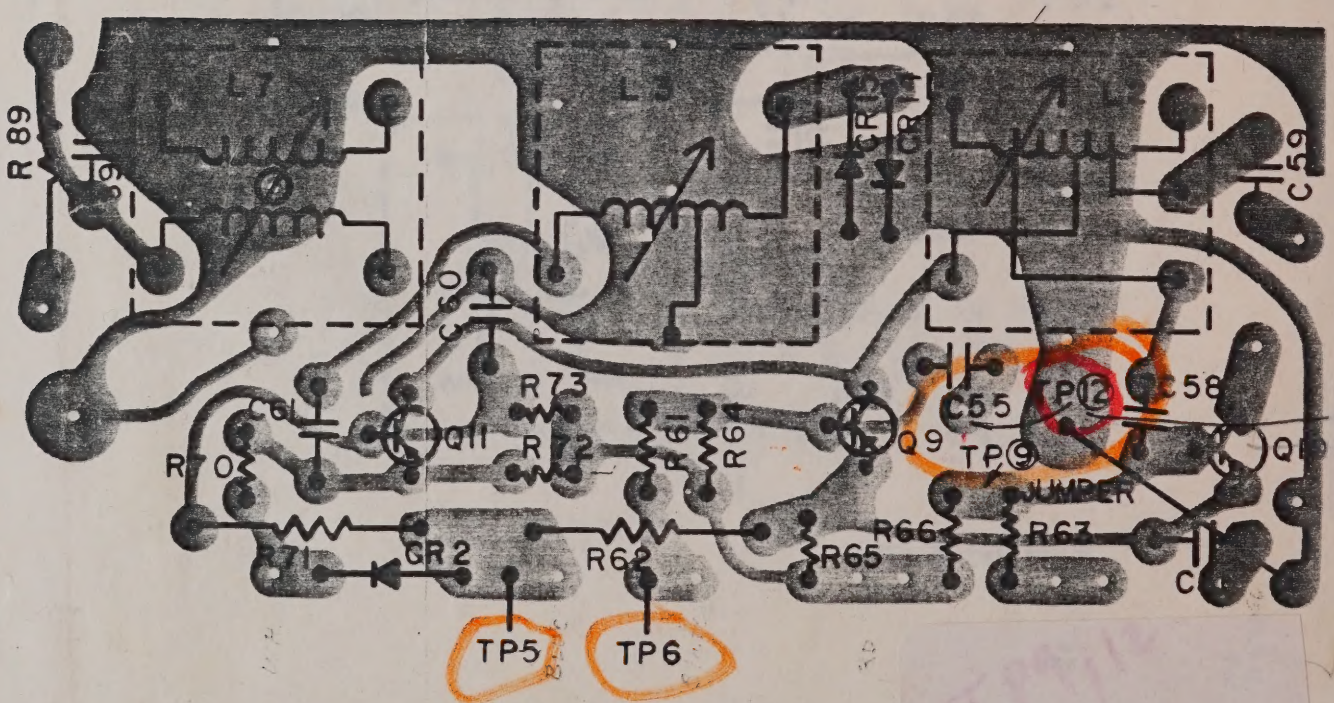
(To R45) 12V — o To Collector Q14

(To R52) 28Ω — o ground (C-40 Bottom)

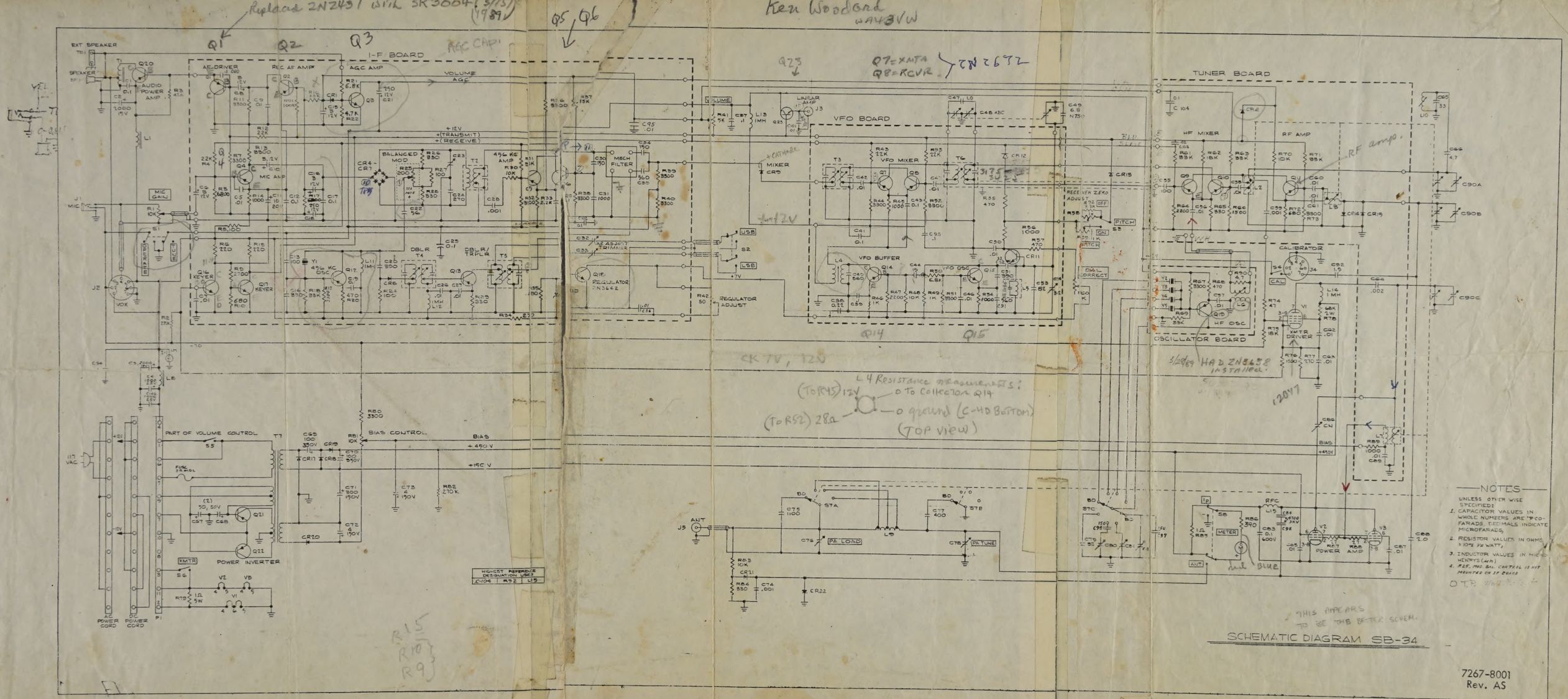
(TOP VIEW)



TUNER BOARD

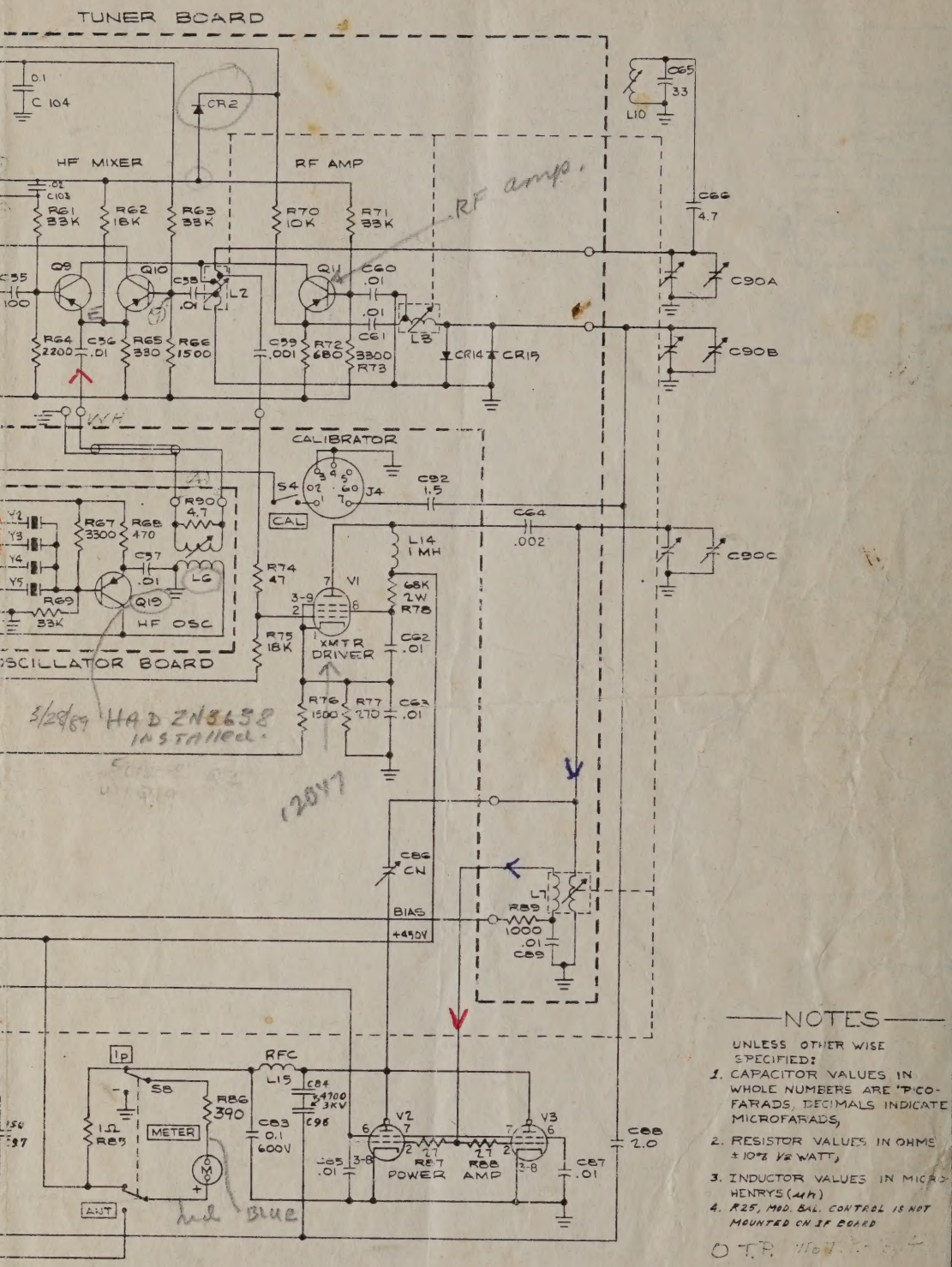


TUNER BOARD BOTTOM



SCHEMATIC DIAGRAM SB-34

7267-8001
Rev. AS



NOTES

UNLESS OTHER WISE SPECIFIED:

1. CAPACITOR VALUES IN WHOLE NUMBERS ARE "PICO-FARADS, DECIMALS INDICATE MICROFARADS,
2. RESISTOR VALUES IN OHMS ± 10% ½ WATT,
3. INDUCTOR VALUES IN MICRO-HENRYS (μh)
4. R25, MOD. BAL. CONTROL IS NOT MOUNTED ON IF BOARD

O.T.P. Wow...

SCHEMATIC DIAGRAM SB-34

7267-8001
Rev. AS